

ANNALS of SURGERY

A Monthly Review of Surgical Science and Practice

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ANNALS *of* SURGERY

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No. 4

THE SIGNIFICANCE OF BACTERIA IN THE BLOOD STREAM FROM A SURGICAL STANDPOINT*

BY WALTON MARTIN, M.D.

OF NEW YORK, N. Y.

SEVERAL years ago I heard a bacteriologist complaining that a certain clinician was asking for blood cultures in nearly all his patients, that the laboratory was being called on for much futile work and much unnecessary expense and that nine-tenths of the examinations yielded information of little or no value, either practically or scientifically.

Since then, whenever a blood culture has been taken in the surgical wards I have asked the purpose of the examination. I have especially inquired of the internes in the hospital what a bacteræmia signified. They have, for the most part, answered that a bacteræmia meant that the bacteria were simply being transported by the blood stream, but that a septicæmia meant that they were growing and multiplying in the circulating blood. Though this answer, which is in accord with the teachings of Wassermann¹ and others of the older masters of bacteriology, could throw no light on the case under discussion, its utterance seemed to give satisfaction.

If we make such a distinction between bacteræmia and septicæmia we are in difficulties. We exclude, probably, all the cases of subacute and chronic sepsis and possibly even the early stages of acute sepsis. It is well recognized to-day that the bacteria in many of these cases are being unloaded into the blood stream from a focus of infection directly communicating with the circulating blood. For example, in septic endocarditis bacteria are constantly passing into the blood stream from the focus on the heart valves and there are numerous cases grouped clinically as septicæmia in which pathogenic bacteria, like the hæmolytic streptococcus, have been repeatedly isolated from the circulating blood and in which recoveries are reported as soon as a definite nidus of infection has been removed or shut off from the blood stream. It has also been shown that the serum and leucocytes of patients suffering from subacute and chronic septicæmia possess powerful opsonic action against the organisms causing the infection.² The bacteria invading the circulating blood are being disposed of there. The microorganisms are not multiplying

* Read before the American Surgical Association, May 1, 1922.

in the blood, but are being poured into the blood. They are being destroyed time after time by the various bactericidal agents of blood serum and body cells.

In the first edition of Zinsser's *Bacteriology*, 1915,³ bacteraemia and septicaemia are used as synonymous. In his last edition, 1922, he amplifies the same idea⁴: "It is an important thing to remember that in all of these septicaemias the presence of the organisms in the blood may not signify that they are actually multiplying in the blood. It is, in our opinion, more likely that the organisms at first simply enter the blood stream from the lesion and are destroyed in the circulation." I think this is the sense in which septicaemia is generally used to-day. It is so used in most of the cases reported as septicaemia in current scientific papers. In an interesting paper by Anderson and Richardson,⁵ in the *British Journal of Surgery*, 1918, it is used in this sense. Dehelly's⁶ opening sentence in a case report is: "One speaks of septicaemia when it is possible to determine by culture the presence of living bacteria in the blood," and the title of a paper by Graham,⁷ in 1916, is: "A Case of Anthrax Septicaemia with Recovery." The only evidence of septicaemia was a single culture showing anthrax bacilli in the circulating blood.

If bacteria of moderate virulence are injected into the veins of a resistant animal, they disappear completely from the circulation in a very short time. Undoubtedly many such bacterial invasions occur in human beings and pass unappreciated. Every hæmatogenous osteomyelitis presupposes a contamination of the blood by microorganisms. It is conceivable that blood cultures might chance to be taken during one of these showers and a bacteraemia would be reported which could hardly be termed a septicaemia; but confusion from this source is avoided if the word bacteraemia is qualified by the words persistent, intermittent or occasional. With this conception of bacteraemia in mind, I have looked over the case histories of patients showing positive blood cultures in St. Luke's Hospital for the last six years, thinking it might be of interest to study the relation of the finding of bacteria in the circulating blood to prognosis, to the focus of infection, to clinical manifestations, etc.

A large percentage of negative blood cultures are always found in any series grouped clinically as sepsis. The size of this group depends on the aim and the astuteness of the clinician, as well as on the technic of the bacteriologist. On the aim, because, if an attempt is made to find bacteraemia in patients with focal lesions, with intermittent septic symptoms, bacteria-free intervals are frequent. On the astuteness, because there is a definite relation between symptoms and the time bacteria are likely to be found. If we select well recognized, far advanced cases of sepsis and make cultures only shortly before death, the percentage of failures will be low.

There have been 496 blood cultures taken. Of these seventy-seven were positive, or about fifteen per cent. During the last year, twenty-three per cent. of the cultures were positive. During the last year on the surgical service at the Presbyterian Hospital there have been 175 blood cultures taken; of these sixty-six, or thirty-seven per cent., were positive.

BACTERIA IN THE BLOOD STREAM

It is safe to say that a single blood culture taken by itself is of little or no value in prognosis. When Lenhartz⁸ wrote, nineteen years ago: "It must be strongly emphasized that it is not necessary to be too hopeless when pathogenic germs are found in the circulating blood, for I have seen even a patient with staphylococcus sepsis with high fever recover, as well as twelve patients with pneumomycosis, several patients with streptococcus sepsis and two with sepsis from bacterium coli "if pathogenic organisms were found in the living blood the condition was regarded as nearly hopeless. I remember talking to a bacteriologist about fourteen or fifteen years ago and hearing him express his surprise that a patient in whom he had found hæmolytic streptococci in the blood had recovered. I remember the scorn with which another bacteriologist spoke of the ignorance of surgeons when we asked him about the prognosis of a case of anthrax in which he had found organisms in the blood stream. The outcome in any given case depends on the number and virulence of bacteria, the resistance of the host and the focal lesion. For example, in our series all nine patients with pneumococcus bacteræmia died. This in no sense represents the mortality in blood stream infection by the pneumococcus. A number of factors must also be considered; one patient had an undrained lung abscess, six had terminal pneumonias following other surgical conditions, two had general pneumococcus peritonitis. Lenhartz (*l. c.*) reported that in twenty-six patients with pneumococci in the blood, twelve recovered and fourteen died. The Presbyterian Hospital statistics show six deaths and two recoveries. An attempt might be made to base an opinion on the number of colonies found in the blood cultures. It is self-evident that a single colony found on a single plate must have a different significance from hundreds of colonies found on every plate, but only by repeated examinations and a comparison of a number of similar cases can an indication be given regarding prognosis. Such an attempt has been made by Sutton and Sevier⁹ in pneumonias. It is well known that in far advanced septic conditions the blood stream is swarming with microorganisms and that at autopsy in such cases organisms may be cultivated from the heart's blood and various organs. The old conception of septicæmia was concerned largely with this condition. The whole question is enormously complicated by variations in virulence in the different strains and the intermittent contamination of the blood stream.

Our series of streptococcus infections furnish an interesting study from another standpoint. There are thirty-seven case reports with a mortality of sixty-two per cent. If we consider separately the cases in which the primary focus of infection was the middle ear, there are ten recoveries and three deaths, or a mortality of twenty-three per cent. In the ten patients that recovered, eight had the jugular ligated immediately after the streptococci were detected in the blood. There were two patients that recovered without ligation; in one there was only a single culture showing one colony. Two patients were very ill with a high temperature when they entered the hospital. Blood cultures showed in both, at the time of operation or before, hæmolytic

streptococci in the blood stream. Their recovery is a striking example of cutting off the source of infection and so stopping the bacteraemia. An observation of Dehelly (*l. c.*) in this connection is interesting. He amputated the leg of a fireman for an infected compound fracture. The patient continued ill and repeated examination showed hæmolytic streptococci in the blood. He reamputated through the thigh. The patient promptly recovered. Thereafter the blood cultures were negative. A most painstaking examination of the amputated stump showed a suppurative thrombophlebitis of a single vein.

In the other six cases, the course from a bacteriological point of view is equally interesting. The patients evidently had a simple mastoiditis, either acute or chronic; several had little or no fever. There was no thought of sinus infection, no blood cultures were taken, a simple or complete mastoid operation, as it is termed, was performed. In each instance there was a sharp temperature reaction following the operation and on the fifth to the eighth day there was a sudden rise in temperature, often accompanied by a chill. Blood cultures were immediately taken and on the following day, when positive cultures were obtained, a second operation was performed and the jugular tied and excised.

The following observation on a patient on whom I operated two years ago for chronic empyema has a similar significance.

The patient was eighteen years old, white and obese. Nine months before he had an operation for metapneumonic empyema. After three months the empyema wound healed but in a few weeks he became ill and the wound was reopened. It had remained in this condition up to the time of admission, opening and discharging for a few weeks and then closing again. On admission to the hospital his temperature was 99. He was not seriously ill. Under gas-oxygen anaesthesia the old scar was removed and a small cavity containing flabby, unhealthy granulations was exposed; there was no free pus. A portion of the thoracic wall overlying the cavity was removed, the wound closed and a large rubber tube left in the angle for drainage. His temperature following the operation was 104, the next day it was 107, he had several chills. Several days later a blood culture showed hæmolytic streptococci. During this period there was no change in the appearance of the wound, there was no retention of wound discharges, there was no redness or swelling of the surrounding skin. Two or three weeks later he developed a phlebitis in the femoral veins and later severe pain in the hip. He recovered.

It is difficult not to believe that the bacteraemia and the accompanying clinical manifestations of septicæmia were coincident with the operation in all these cases.

Anderson and Richardson (*l. c.*) give an example of mild streptococcus sepsis following a gunshot injury in which the infected wound had a similar appearance to that reported in the last case.

"There were two wounds in the thigh, each the size of a florin and extending through the deep fascia into the superficial layers of the subjacent muscle-wounds in which the drainage was perfect, in which there was no retention of

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discharges, the tissues about the wound were soft and painless. A streptococcus was isolated from the blood, the blood then became sterile and the patient appeared to be in normal health for about six days. There was a rise of temperature to 103 and streptococci were again isolated from the blood." This patient also recovered.

It is interesting in both these cases to note that bacteria were entering the blood stream, although there was no evidence of retention of discharges or tension in the tissues.

In the staphylococcus blood stream infections there were twelve recoveries and fourteen deaths. Of the patients that recovered four had osteomyelitis; in three of these there were multiple foci. One of these patients had been operated on for osteomyelitis of the humerus following a mastoid operation when eleven years old. After two years the wound healed and the girl remained well for seven years. Then she had a high temperature and severe pain in the arm. At operation pus was found in the medullary cavity of the humerus, beneath the old scar. Before operation her temperature range was from 99 to 102°, following operation from 102 to 105°. A blood culture taken at this time showed staphylococcus. Here again the bacteræmia seemed to follow definitely the operative interference.

The jarring of an infected bone with hammer and chisel may well dislodge small infected emboli. In the area about every active focus of infection, capillaries, and often small veins, are thrombosed, and many of these thrombi are doubtless infected. Is it not probable that some of these minute infected thrombi are set free? In many instances the jarring may not only loosen thrombi but may break down the protective cellular barrier and cause a progressive, infective thrombophlebitis. Finally the infected thrombus reaches a large trunk and portions of it are swept away into the circulation.

There were seven patients with infections of the lips. Two recovered and five died. Another patient died with staphylococci in the blood stream following the incision of a furuncle on the back. It is often said, and it has been confirmed by experience, that infection is spread, probably through the lymphatics, if incision is made in the indurated and inflamed tissues before there is a definite, visible focal point. I believe cutting through tissues with a sharp knife can do little damage. It is by poking and pressing the wound and thrusting blunt instruments into the inflamed tissues that the damage is done, and I believe that the greatest danger lies, not in the spread through the lymphatics, but in the dislodgment of infected thrombi and the progressive thrombophlebitis of the minute veins set up by these manipulations. An observation made many years ago by Reverdin¹⁰ throws much light on this subject. He dissected out the veins in the body of a patient who had died of general sepsis following an infection of the lip. The jugular was normal, there was a small infected clot, however, projecting into its lumen from one of the tributary veins, and this vein was traced back to the infected focus. The blood stream hurrying by had swept away, from time to time, bacteria

and small portions of infected clot. I believe such infected clots in even the smaller veins are responsible for many of the blood stream infections.

There were six cases recorded of bacteraemia when the port of entry seemed to be the peritoneum; one with *bacillus coli communis*, two with pneumococcus, three with streptococcus. Of these one patient only recovered. In this patient an operation was performed through an intermuscular incision for acute appendicitis. The appendix wall was found thick and the vessels congested; there was no exudate in the peritoneal cavity and no adhesions; the wound was closed without drainage. The blood count on admission had been 18,500 white blood cells, the temperature on admission was 101.2° . On the day following the operation the temperature was 105.4° and remained for two days from 104 to 105° . The wound was then reopened. On opening the peritoneum a purulent exudate escaped. The stump of the appendix was inspected and found in good condition; a drainage tube was introduced. The temperature fell after the second operation, remaining between 100 and 103° for five weeks and then fell to normal. Two days after the second operation blood cultures showed hæmolytic streptococci, eight days later the culture was negative, but two weeks later they were again isolated from the blood stream. She finally recovered and left the hospital two months after admission. The intermittent bacteraemia, the sudden clinical evidence of blood infection following operation, are similar to observations already made. Rapid absorption of bacteria from the peritoneum has long been recognized, so that death may occur from blood infections with little or no reaction on the part of the peritoneum. But this case of chronic streptococcus bacteraemia suggests that from time to time bacteria may pass from the peritoneum into the blood, very much as they would enter from a focus directly communicating with a vein. This observation is not in accord with the generally accepted view based on the experiments of Noetzel,¹¹ that in an inflamed peritoneum the absorption of bacteria does not take place. Is it possible in this instance that a small infected, thrombosed vein was discharging streptococci into the blood stream and that the patient was suffering not only from the toxæmia from the infected peritoneum, but also from a streptococcus bacteraemia from a thrombophlebitis?

In studying the records of cases in which positive cultures are found, it is a very simple matter to arrange them by percentages of recovery and death, metastases, types of organisms, port of entry, main lesions, etc. But a little reflection shows that such a percentage study is of little value; too many concomitant factors are omitted, the number of cultures from each case is insufficient, the number and virulence of the organisms is rarely recorded. Taken, however, with the clinical records, one can reconstruct and surmise the sequence of events to a certain extent. It is the surmises and reflections furnished by such reconstruction that I have attempted to present, I am aware, very imperfectly.

From a practical surgical standpoint a persistent bacteraemia suggests a focus of infection directly communicating with the blood current, even if

BACTERIA IN THE BLOOD STREAM

there are no signs of tissue tension or pent-up wound discharges. It by no means inevitably suggests a hopeless septicæmia, and although a single culture, divorced from clinical observation, is of little help in making a prognosis, still, for the scientific study of infection, etc., for the investigation of the relation of bacterial discharge into the blood to tissue tension, for the study of generalized infections following operations in infected areas and for the study of the relation of the clinical manifestations to the bacterial invasions, it is of the greatest value, and I would urge an intensive study of a few cases rather than the haphazard examination of many cases. It is well to keep in mind that it is impossible to-day to classify bacteria with absolute scientific accuracy, and that the various names given are group names. Differentiation has taken place during the countless ages in which bacteria have been dividing and subdividing on the earth, to a small extent morphological. At least in a morphology we can appreciate, but differences show themselves rather in subtle reactions to surrounding media and in the elaboration of most complex chemical compounds.

I wish to express my thanks to Doctor Wood for allowing me to study the laboratory records at St. Luke's Hospital and to Doctor Whipple for his courtesy in giving me the statistics for the year 1921 from the Presbyterian Hospital.

ST. LUKE'S HOSPITAL SERIES

Recoveries—28

Deaths—49

I.A. *Streptococcus Bacteræmia* Recoveries—14

Diagnosis	Operation
1. Cellulitis of Hand and Forearm, Suppurative Tenosynovitis	Incision and Drainage Amputation of Little Finger
2. Chronic Empyema, Recurrent Thoracic Fistula	Thoracoplasty
3. Acute Appendicitis, Peritonitis	Appendicectomy with Drainage
4. Incomplete Abortion	Curettage
5. Acute Mastoiditis	Mastoidectomy, Resection of Jugular
6. Acute Mastoiditis	Mastoidectomy
7. Acute Mastoiditis, Sinus Thrombosis	Mastoidectomy, Resection of Jugular
8. Acute Mastoiditis Sinus Thrombosis	Mastoidectomy
9. Double Mastoiditis	Mastoidectomy
10. Chronic Otitis Media	Mastoidectomy, Resection of Jugular
11. Acute Otitis Media, Sinus Thrombosis	Mastoidectomy, Resection of Jugular
12. Double Otitis Media	Mastoidectomy
13. Acute Otitis Media, Sinus Thrombosis	Mastoidectomy, Resection of Jugular
14. Otitis Media, Sinus Thrombosis	Mastoidectomy, Resection of Jugular

WALTON MARTIN

I.B. *Streptococcus Bacteræmia Deaths*—23

Diagnosis	Operation
1. Otitis Media, Mastoiditis, Sinus Thrombosis	Mastoidectomy, Ligation of Internal Jugular
2. Otitis Media, Sinus Thrombosis, Diabetes Mellitus	Mastoidectomy
3. Acute Otitis Media, Sinus Thrombosis, Pneumococcus, Meningitis	No Operation
4. Mastoiditis	Mastoidectomy, Ligation of Internal Jugular, Opening Lateral Sinus
5. Acute Mastoiditis, Sinus Thrombosis	Mastoidectomy, Sinusectomy with Resection of Jugular
6. Empyema	Thoracotomy
7. Empyema	Thoracotomy
8. Carbuncle of Neck	Excision of Necrotic Tissue
9. Lobar Pneumonia	No Operation
10. Cellulitis of Toe	No Operation
(Treated by Chiropodist for ingrowing toe nail, slight redness about toe nail.)	
11. Septic Uterus, General Peritonitis	No Operation
12. General Peritonitis	Appendectomy
(Appendix normal. Exudate in peritoneum at time of operation showed streptococcus viridans. Blood culture 3 days later showed streptococcus viridans.)	
13. Infected Adeno-Fibroma of Breast	Mastectomy
14. Incarcerated Ventral Hernia, Infection of Wound	Reduction, Plastic Repair
15. Hypertrophy of Prostate	Prostatectomy
16. Urethral Stricture	Urethrotomy
17. Infected Tenosynovitis and Cellulitis	Incision and Drainage
18. Acute Cervical Adenitis	No Operation
(Tonsils removed one week before admission.)	
19. Popliteal Abscess	Incision and Drainage
20. Ludwigs Angina	Incision and Drainage, Tracheotomy
21. Infected Lacerated Wound of Arm	Amputation of Arm
22. Cerebrospinal Meningitis, Retropharyngeal Abscess	No Operation
23. Cellulitis of Foot, Diabetic Gangrene of Toe	Incision and Drainage

II.A. *Staphylococcus Bacteræmia Recoveries*—12.

Diagnosis	Operation
1. Double Otitis Media	Mastoidectomy
2. Carbuncle of Lip	Incision & Drainage
3. Chronic Otitis Media	Mastoidectomy
4. Uterine Fibromyoma	Supra-Vaginal Hysterectomy, Dilatation and Curettage

BACTERIA IN THE BLOOD STREAM

Diagnosis	Operation
5. Carbuncle of Lip	Incision and Drainage
6. Acute Olecranon Bursitis, Osteomyelitis of Femur	Incision and Drainage
7. Scrotal Abscess	Incision and Drainage
8. Multiple Abscesses of Back and Shoulder	Incision
9. Osteomyelitis of Humerus	Curettage
10. Osteomyelitis of Tibia	Incision and Drainage
11. Osteomyelitis of Fibula	Incision, Curettage and Drainage
12. Osteomyelitis of Humerus Tibia, Femur and Occipital Bone	Amputation of Arm

II.B. *Staphylococcus Bacteræmia Deaths*—14

Diagnosis	Operation
1. Furuncle of Nose	Dressings, Medical Treatment
2. Abscess of Liver	Exploratory Laparotomy, Thoracotomy, Drainage of Abscess
3. Osteomyelitis, Meningitis, Metastatic Abscess	Incision of Abscess, Osteotomy
4. Arteriosclerotic and Diabetic Gangrene of Foot	Amputation Through Upper Third
5. Chronic Otitis Media, Cerebrospinal Meningitis	Mastoidectomy
6. Cellulitis of Nose and Face	No Operation
7. Osteomyelitis of Arm	No Operation
8. Furunculosis	No Operation
9. Inguinal Adenitis	Incision and Drainage
10. Osteomyelitis of Tibia	Incision and Drainage
11. General Septicæmia	No Operation
12. Carbuncle of Face	Incision and Drainage
13. Bilateral Pyelonephrosis, Cystitis	No Operation
14. Cellulitis of Upper Lip, Cavernous Sinus Thrombosis	Incision and Drainage

III. *Pneumococcus Bacteræmia Deaths*—9

Diagnosis	Operation
1. Abscess of Lung	Incision and Drainage
2. Pan-Ophthalmitis	Evisceration of Eye
3. Abscess of Neck	Incision and Drainage
4. Acute Mastoiditis	Mastoidectomy
5. Otitis Media	No Operation
6. Double Otitis Media	Mastoidectomy
7. Double Mastoiditis	Mastoidectomy
8. Peritonitis	Laparotomy with Drainage
9. Peritonitis	Laparotomy with Drainage Appendicectomy

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IV. *Bacillus Coli Communis* Deaths—3

Diagnosis	Operation
1. Hypernephroma	Nephrectomy
2. Acute Appendicitis	Appendicectomy
3. Cholecystitis, Multiple Abscesses of Liver	Cholecystectomy

V. *Paratyphoid* Recoveries—1.

Diagnosis	Operation
1. Retroversion, Hemorrhoids	Suspension, Hemorrhoidectomy, Appendicectomy

VI. *Typhoid* Recoveries—1.

Diagnosis	Operation
1. Typhoid Fever	No Operation

PRESBYTERIAN HOSPITAL SERIES

Recoveries—48

Deaths—37

I. *Streptococcus Bacteræmia* Recoveries—19

Deaths—13

Diagnosis	Recoveries	Deaths
Osteomyelitis	2	0
Suppurative Arthritis	4	2
Empyema	3	1
Hand Infection	1	1
Peritonsillar Abscess	0	1
Incomplete Abortion	2	0
Cellulitis	5	1
Suppurative Thrombophlebitis	1	3
Mastoiditis	1	2
Meningitis	0	2

II. *Staphylococcus Bacteræmia* Recoveries—13

Deaths—16

Diagnosis	Recoveries	Deaths
Carbuncles	5	7
Suppurative Arthritis	3	3
Hand Infections	1	2
Peritonitis	0	2
Cellulitis	2	1
Suppurative Nephritis	1	0
Suppurative Thrombophlebitis	1	1

III. *Pneumococcus Bacteræmia* Recoveries—11

Deaths—3

Diagnosis	Recoveries	Deaths
Osteomyelitis	0	1
Suppurative Arthritis	2	0
Empyema	8	0
Peritonitis	1	1
Meningitis	0	1

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IV. *Bacillus Coli* Recoveries—5

Diagnosis	Deaths—3	
	Recoveries	Deaths
Peritonitis	1	1
Incomplete Abortion	0	1
Cholecystitis	2	0
Suppurative Nephritis	1	1
Suppurative Thrombophlebitis	1	0

V. *Bacillus Protens* Recoveries—0

Diagnosis	Deaths—1	
	Recoveries	Deaths
Suppurative Thrombophlebitis	0	1

VI. *Bacillus Aerogenes* Recoveries—0

Diagnosis	Deaths—1	
	Recoveries	Deaths
Cellulitis	0	1

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THE PERITONEAL MANIFESTATIONS OF CHRONIC MULTIPLE SEROSITIS, CONCATO'S DISEASE*

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ROKITANSKY, the great Bohemian pathologic anatomist, in 1842, described the post-mortem examination of a patient who had died from asthenia. There were found chronic inflammation and partial obliteration of the great serous sacs in the thoracic and abdominal cavities, almost complete obliteration of the pleural sacs, and complete obliteration of the pericardial sac, the result of an antecedent pleuritis and pericarditis. Because of the chronic hypertrophic peritonitis, the liver and spleen had become incased in adhesions, and the small intestines were locked together although they were not locally obstructed. There was a large quantity of fluid in the peritoneal cavity, but no œdema of the lower extremities.

Van Deen, in 1846, gave a clinical description of this pathologic condition, describing the syndrome which is now called multiple serositis. In 1875, Hilton Fagge, one of the most learned physicians of his time gave an excellent description of the disease, reporting in detail cases seen in Guy's Hospital. Curschmann, in 1884, described one phase of the disease under the title, chronic hyperplastic perihepatitis or "iced liver." The phase considered by Curschmann, however, had been described previously by Wilks and Moxon as early as 1875. Comparatively little attention was paid to multiple serositis until 1896, when Pick reported three cases, describing not only the pathologic conditions but summarizing the clinical symptoms. His work was so well done with regard to the pericarditis that this manifestation was given the name of Pick's disease. Pick became obsessed with the idea that the disease was primarily an affection of the pericardium, that the lesions in the pleural and peritoneal cavities were the result of interference with the action of the heart, and that the ascites, so characteristic of these cases, was secondary to the venous engorgement of the liver. Concato, in 1881, gave a most convincing description of the peritoneal manifestations of this curious disease, so that it is sometimes referred to, especially by the Italians who have done much good work on the subject, as Concato's disease. Picchini, in 1901, published an especially interesting paper in which he reported 110 cases, fifty of which were his own. Osler, who was one of the first to recognize the condition, gave it a place in American literature in 1896. His description was followed by papers by Cabot in 1898 and by Herrick in 1902. At that time the disease was considered a rare and unique condition, known to students of pathologic

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anatomy, but seldom recognized clinically. Kelly, in 1903, in a remarkable monograph reviewed the literature to date, and ably discussed the various features of the disease. Since then very little other than corroborative data have been contributed, although excellent papers have appeared by Evans, in 1918, and by Reid, in 1920. However, a large number of cases has been reported which have not as yet been indexed in the literature.

My attention was drawn to multiple serositis more than twenty years ago when I was trying to fathom the cause of an ascites which had been diagnosed as the result of tuberculous peritonitis or cirrhosis of the liver. The patient was explored, after the ascitic accumulation had been evacuated; the peritoneum was enormously thickened and glistening white and bore little or no resemblance to that seen in cases of tuberculous peritonitis or in cases of ascites due to cirrhosis of the liver. The liver was buried in a mass of adhesions, and on cutting through them, the substance of the liver was found normal, although deformed from external pressure. A second similar case was seen some months later in which, besides the appearance described, the area of the small intestines was surrounded by a sheath of thickened peritoneum which bound the intestines down to the spine, and resembled the flattened crown of a derby hat. In both cases an enormous amount of ascitic fluid was present. The pericardial and pleural manifestations of the disease were not recognized, yet it was significant that the first patient gave evidence of a weak heart and that there was some fluid in the chest cavities. It was not until the publication of Kelly's article in 1903, however, that I recognized these two cases as examples of multiple serositis. Since that time we have seen other typical cases.

In reviewing the literature and reports of cases of multiple serositis, it is seen that the symptoms of the disease vary according to the serous cavity which is most extensively involved. When pericardial adhesions causing a crippled heart are more prominent than the pleural and peritoneal manifestations, the latter may be overlooked. In the greater number of cases the ascites is the most prominent feature of the disease and is usually attributed to cirrhosis of the liver or so-called pseudocirrhosis. Evacuation of the ascitic fluid is followed by reaccumulation, although in the course of time this may cease. The amount of fluid removed by successive tapplings in the course of years has been enormous in these cases. Osler describes the case of a child tapped 121 times; Rumpf's patient was tapped 301 times. In one reported case more than 600 gallons of ascitic fluid were removed within five years; the patient remained in fair health until shortly before death. The ascitic fluid is clear and straw-colored with about 3 per cent. of albumin which consigns it to the class of inflammatory exudates.

One has but to read the titles of articles concerning the disease to note the development of knowledge of a condition very general in character. Not only are the cases cited dissimilar in many respects but the pathologic picture varies greatly; in one case obliteration of the pericardial sac is the

noticeable feature, in another obliteration of the pleural sacs. The condition in the peritoneal cavity has often been described as chronic peritonitis, oblitative or adhesive in character, depending on whether the entire peritoneal sac was obliterated or the fluid was absorbed in certain parts of the abdomen with sacculation of the remaining fluid. In nearly all cases perihepatitis is a prominent feature; a mass of adhesions surrounds and binds the liver under the diaphragm. This condition may be mistaken for cirrhosis, but when the shell of adhesions is incised to the surface of the liver the organ is found congested, but not cirrhotic unless a coincident cirrhosis is present. The spleen likewise shows perisplenitis; although it is usually rather large and congested, it does not regularly show chronic splenitis of the type seen in splenic anæmia. In some cases chronic vascular nephritis is a complication. The age of the patients affected varies from childhood to old age, but usually symptoms are initiated under thirty years, and the incidence is about evenly divided between males and females. Every surgeon of experience will remember having seen, in the course of his surgical experience, cases answering more or less to this description, usually with ascites, but occasionally without. The outstanding clinical picture is the development of ascites as a rule slow and painless and without œdema of the lower extremities. However, as Pick points out, if the cardiac complication is serious, there may be a little œdema of the lower extremities in the early stages, which disappears as the affection develops.

It is difficult clinically to distinguish ascites which is the result of multiple serositis from the ascites the result of cirrhosis of the liver, chronic splenitis of the splenic anæmia type, and tuberculous peritonitis. Tuberculous peritonitis is often associated with this condition, but while many observers have attempted to show that all cases are tuberculous, it has been proved that a very large percentage are not tuberculous.

Portal cirrhosis of the liver of the Laennec type is occasionally associated with multiple serositis. Hale White said that in most cases of portal cirrhosis of the liver with ascites, the ascites is a terminal symptom and the patient does not long survive the first tapping. This would indicate that many of the cases which have been diagnosed portal cirrhosis, in which frequent tapplings have been made, are cases of peritoneal serositis, or cirrhosis of the liver associated with this form of chronic peritonitis. Equally interesting is the work of Fagge, who showed that in 10 per cent. of cases in which death resulted from cirrhosis of the liver tuberculosis of the peritoneum was an associated condition.

Etiology.—Many investigators believe that serositis is caused by some type of bacteria which affects the serous surfaces only. While bacteria, especially the bacilli of tuberculosis, have been detected, they are found so infrequently as to lead to the belief that they are accidental rather than causative. Rosenow's work on the specificity of bacteria is interesting in this connection. Certain writers believe that the disease is chemical in

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nature and has its origin in the liver, unidentified toxins passing from the liver to the perihepatic peritoneum, and that the disease always begins as perihepatitis.

Twenty years ago, extensive investigation, especially by Clark in 1901 and by Dudgeon and Sargent in 1905, advanced our knowledge of the absorptive capacity of the peritoneal cavity. It is known that while fluids are absorbed readily by the peritoneum and enter the portal circulation, solid particles are taken up only by the central tendon of the diaphragm and pass into the mediastinal spaces. It is supposed that in this syndrome the causative agents pass from the mediastinal spaces to the lymphatics and the blood stream and are carried through the blood to the pericardium and the pleuræ, or, the reverse of this process is exemplified. A consideration of events leads to the belief that the causative agents act more directly; otherwise, why should this serositis be confined to the pericardium, the pleural sacs, and the peritoneum? If the causative agents were carried by the blood, the serous surfaces of the brain, the spinal cord, and the joints would be affected, but this does not occur in a proportion to be more than a coincidence.

From a surgical standpoint we are concerned with cases of long continued ascites, perhaps extending over years, for which repeated tapplings have been done. Cases have been reported in which the ascites has diminished gradually, eventuating in obliteration of the peritoneal cavity and absorption of the fluid. There appears to be little of a curative nature that can be done for the relief of the condition in the terminal stage. Perhaps some of the reported Talma-Morison operations have been performed in cases of multiple serositis in the belief that the condition was uncomplicated cirrhosis of the liver. We must remember that diagnosticians have not been on the lookout for these cases. As a matter of fact, the condition had been diagnosed clinically in less than 10 per cent. of the cases reported. Our knowledge has come largely from the necropsy room where the pathologist can view the whole picture, while the surgeon's exploration has been limited to the abdominal cavity. We may be taking a much gloomier view of the prognosis of this condition than is warranted. I remember a number of cases in which I operated for other conditions and found perihepatitis and chronic peritonitis without recognizing the nature of these serous manifestations; yet the patients recovered and remained well. There seems to be no inherent reason why this type of chronic peritonitis should always go to the post-mortem stage. I have no doubt that in operating for various conditions we remove causes of chronic peritonitis with the recovery of the patient without appreciating this phase of the situation. Now that our attention is focussed on the condition I believe we shall discover it very often and find that it is benign rather than malignant, and in some cases even a conservative or beneficent process.

Multiple serositis is a poor term for this syndrome, which probably does not represent a definite disease, but rather a manifestation of chronic serous

inflammation of three contiguous serous sacs, the pericardium, the pleuræ and the peritoneum, the result of many causes which we have heretofore recognized only in the terminal stage.

Recently a girl (Case A338275), suffering from the abdominal manifestations of multiple serositis besides a huge ovarian cyst, came under my care. The total weight of the tumor and ascitic fluid was 161 pounds; the girl weighed 107 pounds after the operation. The cyst, which was malignant, had perforated, and masses of carcinoma were freely exposed in the peritoneal cavity. The patient had been explored by excellent surgeons two years before who found the carcinoma, evacuated a large amount of fluid, and closed the abdomen without removing the cysts because of the malignancy. The peritoneum, therefore, had been exposed to fungating adenocarcinoma for two years, and probably much longer, yet there was no metastasis to the peritoneum, indicating that the sclerosed peritoneum, being without sufficient circulation to enable secondary growth to take place, afforded a poor soil for transplants. An interesting feature of the operation was that in spite of the great size of the tumor the patient was not cyanosed and had no especial difficulty in breathing or heart action. The very moderate evidence of the disease in the pericardium and the presence of fluid in the pleuræ, were thought to be the result of the pressure of the tumor. The fluid contents were emptied very slowly, since experience with large abdominal tumors had shown that sudden removal of the tension is liable to cause syncope. What was my surprise, after emptying all the fluid and removing the tumor completely, to find that the patient continued to breathe with ease, owing to the fact that the "iced liver" and the adherent spleen maintained fixation of the diaphragm. The adhesions in the pericardial sac and pleuræ had also helped to prevent upward pressure, so that when the tumor was removed the great cavity maintained much the shape of a half barrel without movement of the viscera. Excellent recovery followed; there was no return of fluid.

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THYROID SURGERY AND THE DEMENTIA PRÆCOX SYNDROME*

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DEMENTIA PRÆCOX, according to Kraepelin,¹ consists of a series of states, the common characteristic of which is a peculiar destruction of the internal connections of the psychic personality. The effects of this injury predominate in the emotional and volitional spheres of mental life. The assertion that this is a distinct disease has met with repeated and decided opposition.

It is the aim of this paper to record clinical observations which apparently support the suspicion that a very close relation exists between endocrine imbalance and dementia præcox.

Kraepelin, Cushing, Lewis and Davies, among others, have studied a practical aspect of mental disease and endocrine imbalance which is of interest to surgeons who have to do with thyroid diseases. This phase concerns the treatment of this and other forms of insanity by attacking directly the endocrine gland itself by surgical or non-surgical methods. Recently Lewis and Davies² have reported a considerable number of cases in which the psychic syndrome of dementia præcox was favorably influenced by thyroid extract therapy and hemi-thyroidectomy, chiefly the former. Most of their cases were of the sluggish, apathetic, introversion, hypoglandular type. These were treated with thyroid extract. Some were schizophrenic with paranoid symptoms, agitation, excitement, etc., and were classed as cases of hyperthyroidism. These authors suggest that their rather satisfactory attempts at treatment of dementia præcox through thyroid surgery and medication should be interpreted in terms of possibilities and not in terms of demonstrated facts or permanent achievements.

In the writers' cases it was the circumstance that dementia præcox was observed in four instances associated with only slight aberration in size and form of the thyroid gland, but not associated with the symptoms of frank thyrotoxicosis, which marked the cases as unusual and perhaps significant in some degree. Since all of the clinical symptoms of Graves' disease are largely of nervous origin, and all are emotional, many cases exhibiting rather definite forms of nervous and mental disease as mania, chorea, hysteria, etc., it is not at all surprising that the rather definite clinical syndrome of dementia præcox appears occasionally in connection with thyrotoxicosis. It is because of the clinical relief of dementia præcox, unassociated with Basedow's disease "in sensu strictiori," through apparent correction of endocrine imbalance by hemi-thyroidectomy, that a report is submitted.

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The diagnosis of endocrine imbalance with the probable site of the injury in the thyroid was made in each instance by Dr. Lillian Crockett Lowder, of Indianapolis, in whose practice the cases occurred.

CASE I.—White female, age twenty-two. *Family History:* Mother and father are both living and in good health. There is no record of cancer, tuberculosis or mental and nervous disease. The family history as to goitre is noteworthy. On the paternal side the history is negative as to goitre. On the maternal side the grandmother had a simple goitre, two great-aunts had exophthalmic goitre, the mother has a simple goitre, one aunt has exophthalmic goitre and one brother has a simple goitre; likewise a sister who died at the age of thirteen had a distinctly enlarged thyroid gland.

Personal History: As a young girl the patient enjoyed good health with the exception of the usual childhood diseases. At the age of eighteen she began to feel that her strength was not the equal of that of her associates. She was graduated at high school and became a stenographer and for three years was employed in this work, after which she became indolent and quarrelsome, exhibiting introspection and introversion, in that she remained secluded in her room and avoided social contact wherever and whenever possible. Her habits became more and more solitary. She developed a violent hatred for her father, declaring that she was not his daughter and accusing him of attempts to poison her. She spent many hours wandering alone in the streets.

Physical Findings: The patient is a moderately well-built girl apparently about twenty-five years old. The eyes react well and there is a very slight degree of exophthalmos. Hyperopic astigmatism is present. The fundus is normal. There is a moderate enlargement of the right lobe of the thyroid and isthmus. Chest, abdomen and pelvis negative. There is a slight acceleration of the pulse, the rate being eighty to ninety a minute. The deep and superficial reflexes are exaggerated, especially the left patellar reflex. There is a slight tremor of the fingers. Blood and spinal Wassermann negative.

Personal History in the Hospital: The patient hid her toilet articles and house-slippers in the garbage can, occasionally wandering away from the institution to be found hidden or wandering aimlessly, clad in a thin nightdress, at zero temperature, in the streets. She described vocal hallucinations which she interpreted as the voices of God, Jesus and the Virgin Mary, which, as she said, had told her to put the articles in the garbage can. The voices quoted passages from the Bible and Science and Health.

Diagnosis: Dementia præcox, paranoid form.

Treatment: Hemi-thyroidectomy.

Result: After two weeks, the young woman returned to her normal mentality. She resumed her secretarial work, and for the entire period intervening since her operation, almost a year, she has been quite free of signs of mental aberration.

CASE II.—Female, age fifty-four, married. *Family History:* Negative as to goitre and insanity.

Personal History: That of a healthy woman until the age of fifty-three, at which time she became irritable and easily excited. She became jealous of her husband without cause and was convinced that a conspiracy existed between her husband and her nurse in which her destruction was planned. She developed violent hatred for her husband and made homicidal threats; she made several vicious attacks upon her husband's person. She heard threatening and insulting voices and was finally committed to an insane hospital.

Physical Findings: The eye ground is normal and there is no exophthalmos present; other ocular signs of Basedow's diseases are absent. The pulse-rate ranges

from ninety to one hundred. There is some precordial distress and slight fine tremor. There is no anasarca. The patient has lost about thirty pounds in weight. Examination of the thyroid gland reveals moderate enlargement of the right lobe and isthmus.

Treatment: Hemi-thyroidectomy was performed without apparent benefit so far as the psychosis was concerned until a period of five months had elapsed, after which the mental symptoms gradually disappeared and have not returned to the present time, which is four years after the thyroidectomy.

CASE III.—Female, age twenty-one. *Family History:* Negative as to cancer, lues and tuberculosis. Father was an alcoholic. An elder sister had a simple goitre.

Personal History: Patient has had excellent health until present illness, excelling in basket-ball and tennis and holding the world's pole-vaulting record for women. Her class work at Indiana University was excellent. After graduation she procured a position as instructress in athletics. After a few months she began to shirk her work and became quarrelsome and neglectful of all her duties. She developed a marked hatred toward her relatives and accused them of conspiring against her welfare. There were other distinct phobias. She refused to go out on the street for fear of evil befalling her and demanded removal from her home because of her fear and hatred of a kind and indulgent mother.

Physical Findings: Very slight exophthalmos and enlargement of the right lobe of the thyroid. Pulse somewhat accelerated. There was a coarse tremor of slight degree observed in the fingers. After thyroidectomy the psychosis disappeared, and at this time, almost six years after the operation, the patient is in perfect health and is an instructress in the high school of Palm Beach, Florida.

CASE IV.—Female, age twenty-seven. *Family History:* Negative as to goitre and insanity.

Personal History: Patient, who had been an industrious and amiable young woman, was dismissed as a teacher because of her vulgar and quarrelsome attitude toward her pupils. This action was taken by the school board on complaint of parents. She was extremely agitated and described auditory hallucinations and delusions of persecution. She developed hatred for her husband, resulting in divorce, because of her angry tirades and threats of violence. She lived in a tormented state of distrust of her friends and relatives.

Physical Findings: The eye ground was normal and there were no ocular signs of Basedow's disease and no tremor except when patient was especially agitated and combative. Unilateral enlargement of the thyroid gland was present.

Treatment: Hemi-thyroidectomy.

Result: Relief of psychosis. The patient, though somewhat nervous, is able to carry on her work as teacher.

There is a large amount of evidence to show that there is a functional correlation between the ductless glands and the nervous system, but the exact nature and extent of this correlation have been explained on such varying and contradictory hypotheses by different investigators that the resultant deductions are rather unsatisfactory. Thus, Berkley,³ in 1908, reported ten cases of thyroidectomy for catatonic dementia præcox with brilliant results. The after-course of the cases coincided with his belief that the condition was primarily one of hyperthyroidism. In those patients whose thyroids subsequently enlarged, there was an immediate return of catatonia, mutism, etc., which disturbances in turn disappeared as the gland spontaneously diminished

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in size. Since thyroid secretion is an accelerator principle, activating the nervous system to a hyperexcitability, it is rather surprising to find cases of catatonia, a condition associated with apathy and negativism, relieved by thyroidectomy. The report of Kanavel and Pollock,⁴ who obtained negative results from thyroidectomy in twelve cases of catatonic dementia præcox, falls more in line with our present physiologic conceptions.

Working along somewhat different lines but upon the same problem, Uyematsu⁵ found the blood clotting time of catatonic dementia præcox cases definitely shortened. Hypersecretion of the thyroid gland is accompanied by a prolonged coagulation period of the blood, while hyposecretion is usually associated with shortening of the same. Here is an interesting similarity between catatonia and hypothyroidism. The hæmatologic study also points to another remarkable resemblance between these two conditions in that the platelet counts in myxœdema, cretinism and catatonic dementia præcox are exceedingly increased. In the matter of sugar tolerance Lewis and Davies⁶ have also pointed out the similarity, since in both catatonic dementia præcox and hyperthyroidism there is a markedly increased tolerance. The one case in their report showing a delayed absorption phenomenon was of paranoid dementia præcox manifesting definite signs of hyperthyroidism.

While it would thus seem that the catatonic form of dementia præcox has been rather definitely identified with a deficient secretion of the thyroid gland, we have been unable to find any reports to show the nature of the relationship, if any exist, between the agitated and paranoid types of dementia præcox and the thyroid gland. It was an inquiry into this relationship that the following investigation was made at the Central Insane Hospital at Indianapolis. Consecutive cases of dementia præcox, irrespective of type, were examined for signs of endocrine imbalance. Special attention was paid to thyroid hypertrophy. Since anatomic variation might enter largely into such an investigation, care was exercised to record thyroids as enlarged, only when they were visibly hypertrophied.

Of twenty-seven male patients, eleven, or forty per cent., presented some degree of thyroid hypertrophy. Of this number two had large goitres, six showed a conspicuous enlargement, while the remaining three manifested a moderate hypertrophy of one or both lobes. Twelve of the men presented definite signs of vasomotor disturbances, especially in the hands, which in eight cases, or twenty-nine per cent., were characteristically purple and cold. Six cases, all over twenty-one years, had little or no beard, the hair elsewhere on the body, however, appearing normal. Three cases showed underdeveloped genitals. One case presented, in addition to a markedly enlarged thyroid and cold hands, an outstanding overgrowth of the long bones. It is interesting to note that of five cases of catatonic dementia præcox among the group, not one showed any thyroid enlargement.

Of seventy-four female patients, forty-eight, or sixty-four per cent., presented some degree of thyroid hypertrophy. The number of actual goitres

in the group was surprising, amounting to eighteen in number, or twenty-four per cent. Of these eighteen, nine exhibited goitres that were apparently cystic, four had median lobe enlargement and two had discharging sinuses from the goitre, evidently due to a purulent thyroiditis. Menstrual disorders were common, over one-half of the women complaining of irregularity and ten who were under thirty-five did not menstruate. As in the male patients, vasomotor disorders were conspicuous, eighteen of the women, or twenty-three per cent., presenting the cold, purplish hands noted in the men. Four women had an abnormal growth of hair on the face.

In both the male and female patients, the cardinal symptoms of thyrotoxicosis, with the exception of goitre, were notably absent.

It has been observed that a certain percentage of cases of dementia præcox, more particularly those of the catatonic and hebephrenic types, suffer from marked constitutional disorders, more prominently, insomnia, cyanosis, emaciation, circulatory and vasomotor disturbances and disturbed cardiac action. These symptoms, together with the early age incidence of the disease, have naturally led investigators to correlate it with the concomitant ovarian, testicular and thyroid changes. In lieu of a more satisfactory explanation of these physical findings, they have usually been regarded as subsidiary and resultant upon the primary mental changes. These facts are noted by Jelliffe,⁷ who is of the opinion that, despite them, dementia præcox must as yet be looked upon as simply an "introversion psychosis," a term which describes the most characteristic quality of the disease but goes no further.

Rather constant and definite regressive changes in the testes and ovaries of dementia præcox cases were found by Sir Frederick Mott.⁸ Of course he did not conclude that dementia præcox is caused by such changes, but remarks that this close association, to be understood, will require much further investigation. Hemmeter and Friedman, on the other hand, have with apparent justice claimed that all ductless gland disturbances may manifest themselves clinically without macro- or microscopic alterations of these structures.

If it is true that an abnormal condition of the ductless glands, resulting in an endocrine failure or disorder of the endocrine equilibrium, has a causative relation to dementia præcox, one might expect to discover a structural defect or change in the corresponding glands at autopsy. Kojima,⁹ who examined the ductless glands of two cases of dementia præcox post-mortem, comes to the conclusions that in males there is a tendency to hypofunction and in females to hyperfunction of the thyroid. Microscopically, he found that the thyroid vesicles vary in size and are distended with colloid, that there is an excess of intravesicular connective tissue and a flattening of the epithelial cells. Ramadier and Marchand⁹ found in a female case, age seventeen, a gland that weighed five grams, in which there was a marked sclerosis. In four other cases they found more or less sclerotic changes, an atrophy of the vesicles and a great variation in the quantity of colloid; in one case no changes

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were observed. On the other hand, Parhon and others found no sclerotic changes, but a marked distention of colloid in the vesicles. It would thus appear that while there are undoubtedly structural changes in the thyroids of some dementia præcox cases, these changes are not definite or constant, in some instances there being a hyperfunction, in others a sclerosis associated with hypofunction.

Berkley thought that by resection of a lobe of the thyroid gland he could increase the blood supply to the parathyroids. He recommended the administration of lecithin at the same time. This procedure has been repeated several times by Judin, in two cases, by van der Scheer in seven cases, almost always without results. Van der Scheer saw improvement in two cases of which the one ran its course with Basedow's phenomena, the other exhibiting struma. Pinheiro and Reidel report somewhat more favorable results. Pinheiro observed improvement after administration of parathyroidin. The pulse and disorders of metabolism were found by him to be influenced favorably. Many years ago Kraepelin endeavored for a long time to influence dementia præcox by the use of extracts of almost every possible organ, including the thyroid gland, the testes and the ovaries, but unfortunately without any effect.

It seems reasonable at this time to regard thyroid therapy as a therapeutic agent in dementia præcox with doubting expectancy as its maximum appraisal, notwithstanding that its application in some cases has been followed by improvement or recovery.

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CONGENITAL HYPERTROPHIC STENOSIS OF THE PYLORUS IN THE ADULT*

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ONE of the greatest diagnostic feats of medicine was the recognition in 1788, by Beardsley, an American, of the condition known as congenital hypertrophic stenosis. Following the description by Beardsley, no definite exposition of this condition occurred until 1879. In that year Heinrich Landerer, of the University of Freiburg, gave the first real description of the disease. He not only discussed the congenital form, which is by far the most common, but he also described ten cases of narrowing of the pyloric outlet in adults (43-63 years of age). In these cases there were no pathological changes other than a simple narrowing of the pyloric orifice. The stomach was markedly dilated but no thickening of the pylorus was noted in any case.

In 1888 Hirshprung wrote his classical paper on "Congenital Hypertrophic Stenosis of the Pylorus." This paper established the disease as a definite clinical and pathological entity. John Thomson published his paper nine years later (1897). Following the above papers, many contributions have been made which have confirmed these early observations. A rather recent contribution is the observation that hypertrophy of the pylorus is frequently associated with enlargement of the thymus gland. The exact relationship between these two phenomena is not clear but it affords much ground for speculation.

Four theories as to the causation of this condition have been advanced. It is probable that a combination of these theories approximates the truth. The most common theory is that it is a developmental overgrowth. A second hypothesis is that we are dealing with a primary spasm resulting from local irritation followed by muscular hypertrophy. Third—it has been suggested that there is a congenital narrowing of the pyloric lumen followed by hypertrophy. Lastly, some advocate the idea that there exists a functional disorder of the nerves to the stomach and duodenum, leading to an ill coördination and, therefore, an antagonistic action of their muscular arrangement. Such a functional nervous derangement occurring per se seems most unusual. Like most other functional disturbances, investigation will probably show a direct underlying cause.

Such are the interpretations of the etiology of congenital hypertrophic stenosis in the infant. In this paper our discussion concerns congenital hypertrophic stenosis in the adult. True hypertrophic stenosis in the adult must, perforce, have the same etiological basis as the infantile form. We

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are simply dealing with a congenital condition which persists into adult life. Such causes as chronic gastric or duodenal ulcer with cicatrization and secondary stenosis must of course be ruled out. Likewise, gastric carcinoma, adenomata, syphilis, tuberculosis, typhoid fever and hypertrophic gastritis, while being of great importance with regard to differential diagnosis and pathology, are obviously not to be confused in the discussion of its etiology. The etiology of the infantile and adult forms are identical because we are dealing with the same condition. The adult form is extremely rare, largely because, if unrecognized in infancy, the child dies before attaining maturity.

There are several conditions in the adult which may closely resemble congenital hypertrophic stenosis. The most common ones are carcinoma of the pylorus, peptic ulcer with stenosis of the pylorus, sarcoma and syphilis. Tuberculosis, though rare, must also be considered. Actinomycosis and typhoid ulceration are extremely rare and hardly to be confused.

The differential diagnosis of these conditions is fully discussed in various text-books and will not be entered into here.

Previous Case Reports.—Stenosis of the pylorus in adults has been previously described in medical literature. Most of the reported cases, however, are those forms of stenosis which are secondary in nature. I refer mainly to those cases following gastric carcinoma involving the pylorus, gastric or duodenal ulcer with cicatrization, syphilis of the stomach and other diseases which leave an obstructive lesion at the pylorus. These cases are essentially of different origin from true uncomplicated pyloric stenosis.

Cautley and Dent, in 1902, mention three cases of pyloric stenosis in individuals aged six, eleven and twenty-two years respectively. They believed all three of these cases to be of congenital origin. The cases here referred to were cases of simple stenosis of the pylorus without hypertrophy. The congenital origin of a simple stenosis of the pylorus without the muscular hypertrophy would be exceedingly difficult to prove.

Maylard, of Glasgow, in 1904 suggests, in a paper entitled "Congenital Narrowness of the Pyloric Orifice," that many cases of chronic gastric derangement are due to this cause. These observations were made from operative procedures in which the stomachs were examined. He, also, recorded a case of hypertrophic stenosis in a man, aged thirty-one years, which he believed to be congenital in origin.

Mayo Robson and Moynihan in 1904 expressed the belief that it is likely that such conditions may exist, but that the evidence offered was not sufficient to establish its identity.

Russell describes three cases of simple stenosis in adults that he thought were of congenital origin. The evidence furnished leaves considerable room for doubt. One case of hypertrophic stenosis reported by the same author was undoubtedly carcinoma, as malignancy was definitely present at the fundus.

These are the only references I have been able to find dealing with the subject at hand. The case described by Maylard of Glasgow was probably the first example on record, but, unfortunately, it was impossible to establish its origin. The history obtainable was very meagre and nothing was known of the infantile record of the case.

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REPORT OF CASE

Mr. J. G., lithographer, aged fifty-one, was first seen on December 27, 1919. He was referred by Dr. R. Gaston, for surgical treatment. His chief complaints were gastric distress (dyspepsia), excessive vomiting, sour eructations and progressive loss of weight. The duration of his present illness was indefinite (about one year), but he stated he had had stomach trouble all his life. He would have periods of relief for several months at a time, followed always by a return of his trouble. Between the ages of eighteen and thirty-five he was relatively free from attacks and during this time he steadily increased in weight until he weighed about 170 pounds. Since that time (sixteen years ago), he has lost weight and in the last year has declined rapidly, until his weight is 103 pounds. His mother states that when he was an infant "she had a terrible time raising him." He was under-nourished, vomited a great deal, and was markedly under weight. As a young child he suffered periodically from "biliousness" and vomiting. He never suffered from any localized pain, merely a sense of fullness, followed by vomiting of large amounts of partially digested food and mucus. No definite history of his condition could be obtained prior to the time he was seen by Doctor Gaston, other than the above description.

For eight years prior to operation was constantly under medical care, without receiving any benefit. Previous to that time he was not bothered so much, but on looking back he thinks he may have had milder manifestations, but as they had always been present did not realize that there was anything wrong with him.

At the time we first saw him, he appeared cachectic and his features were peculiarly similar to patients suffering from advanced carcinoma. His complexion was of a sallow, pasty nature. The eyeballs were quite prominent, the malar eminences protruded and the cheeks were sunken and drawn; his whole appearance was one that bespoke despair. The neck was wasted and the sternomastoid muscles were sharply outlined. The thyroid gland was not enlarged. There were no abnormal pulsations in the neck, but the veins of the neck and forehead were quite distended. The chest was symmetrical and the expansion equal on the two sides. The ribs and the intercostal spaces were easily seen. No pathological findings were noted in the heart and lungs.

The examination of the abdomen was of great interest. The upper abdomen was distended, the distention extended down below the umbilicus about one and a half inches. The abdomen was soft and there were no signs of any inflammatory disturbance. Tenderness and pain were absent, except for a feeling of discomfort on pressure in the epigastrium. The lower abdomen and pelvis were apparently normal. No free fluid could be detected in the abdomen. The stomach was very greatly dilated, this being the cause of the distention above noted. The outline of the stomach could be easily mapped out. Marked peristaltic waves were visible traveling periodically from left to right. These waves were easily induced by tapping the abdomen with the finger. They were periodic in nature, being synchronous, of course, with the muscular contractions of the stomach. A small, hard mass could be felt on palpation at the pylorus, just to the right of the mid-line, slightly below the umbilicus. This mass appeared to be about the size of an olive.

Examination of the extremities revealed no abnormal findings. There was no adenopathy present; the inguinal, cervical and axillary glands exhibited no enlargement on palpation. The X-ray examination revealed an obstruction at the pylorus, which was thought by the X-ray man, Dr. S. Lange, to be due either to an ulcer or to carcinoma. His report is as follows: "The X-ray pictures reveal a marked obstruction at the pyloric end of the stomach. The findings are suggestive either of an ulcer, with stenosis of the pylorus, or carcinoma. An exact statement cannot be made."

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Gastric lavage revealed several interesting and instructive findings. It was necessary to wash out the stomach numerous times to afford relief from the excessive vomiting present. He experienced immediate relief after each lavage. The character of the wash was very instructive. Six or eight quarts of water had to be used each time before the fluid was returned clear. There was a great deal of undigested food present, particles of food that were eaten eight days previously being found in the return fluid. After washing the stomach completely of its contents and emptying it, it was frequently necessary to introduce three quarts of water before any siphonage was established. This of course, suggested the great dilatation present, large quantities being necessary to induce antiperistalsis. The stomach contents were not colored with bile, the color being light yellow and turbid because of the admixture of food. The vomitus had a sour, rancid odor due largely to the fermentation present in the stomach. On analysis, the stomach contents showed a hypo-acidity, a reduction in both the free HCl and combined HCl being present (free HCl 1005, combined 1020). Lactic acid was also present, as well as numerous bacteria. No Boaz Oppler bacilli were found. Bile was not present. Several analyses were made and they all revealed a marked hypo-acidity.

The findings above recorded suggested either an ulcer of the pylorus with secondary cicatrization and obstruction, or carcinoma of the pylorus, with the probabilities being in favor of the latter diagnosis. A laparotomy was advised and it was suggested that a posterior gastro-enterostomy be performed. The patient willingly gave his consent and the operation was performed on December 29, 1919.

Operation. The patient's stomach was thoroughly emptied the night before, and no food given either the evening before or the morning of operation. He was given the usual preparatory treatment.

Digital examination revealed an annular thickening at the pylorus extending about one and a half to two inches. The thickening was noted to be present for about one-half inch beyond the pyloric ring. It was an annular hypertrophy about the consistency of cartilage, and smooth throughout. The mesenteric glands in the neighborhood of the stomach and duodenum were not enlarged. No evidence of an ulcer with cicatrization was found. There was no scar tissue present. The absence of enlarged glands, the cartilaginous, smooth, even character of the thickening to the touch and the smooth, glistening appearance on examination, were quite different from the findings in carcinoma. The hypertrophy was distinctly confined to the muscular and submucous layers and was uniform throughout as demonstrated later by incision. The stomach was enormously dilated, and looked like a large collapsed sac. The pyloric orifice was tightly contracted. It was decided that a Rammstedt operation be done because of the marked similarity between this case and the condition found in the congenital stenosis of infants. The pylorus was correspondingly slit longitudinally through the submucous layer to the mucosa, for about one and a half inches. This at once relieved the stenosis. The finger could now be pushed through the pyloric opening with ease. After relieving the stenosis as described above, the abdomen was closed in the usual manner. A diagnosis of congenital hypertrophic stenosis of the pylorus in the adult was made at operation.

Following the operation the patient had an almost uncomplicated convalescence. He was allowed to take fluids the day after operation. He retained all the food taken and suffered no nausea or vomiting. After a few days a light diet was allowed and it was taken with relish. He was encouraged to drink plenty of water. His appetite became ravenous within a week's time. For the first time in years he was having normal bowel movements each morning. The stools were of good consistency and well formed. The patient was put on a general diet

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after the first week. On January 20, 1920, he was discharged. He had gained seven pounds and felt greatly benefited. The patient was placed under Doctor Gaston's supervision after leaving the hospital.

In September, 1920, nine months after operation, he was seen at the office. He has gained 30 pounds in weight, now weighing 130 pounds. He states that he eats freely of various kinds of food and that his appetite is very good. His stomach is still somewhat dilated but much smaller than before operation. His general health is excellent and he presents an amazing difference in appearance from the man of nine months ago.

Treatment.—The treatment in the above case differs from the previous cases reported in the employment of the Rammstedt operation. Maylard and Russell both performed posterior gastro-enterostomies in their cases. It was thought that if the Rammstedt operation produced such excellent results in infants, with consequent less shock and trauma, in adults too it should be preferable. The use of the Rammstedt operation, likewise, obviates the necessity of diverting food from its normal channel and, hence, produces none of the digestive defects that often follow gastro-enterostomy. The simplest method of relieving the obstruction present, should be the operation of choice. In this case, simple division of the muscular and submucous layers of the pylorus produced eminently satisfactory results.

September 1, 1921. Patient was seen on above date and his condition remains substantially the same as reported one year ago. There is still a slight dilatation of the stomach present but he is practically free from symptoms and looks exceedingly well. His weight is at present 140 pounds, his color good and appetite excellent. His general condition is decidedly satisfactory. *January 16, 1922.* The patient has remained in good condition and is entirely free from symptoms of obstruction. His weight remains at 140 pounds and his general appearance is that of a man in good health.

SURGICAL TREATMENT OF SYPHILIS OF THE STOMACH*

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It is only within very recent years that syphilis of the stomach has been taken out of the realm of rare medical curiosities and has been recognized as a condition of sufficient frequency to warrant serious attention. Curtis¹ as recently as 1909 made the significant statement that in only two of the sixteen cases then in the literature had complications arisen which were amenable to treatment. Perforation of ulcers had occurred in both of these cases, one of which was reported by Fraenkel² and the other by Flexner.³ The application of the Wassermann reaction and the development of the X-ray examination of the stomach have led not only to the recognition of the greater frequency of these cases, but also to the diagnosis of many of them even without operation. The literature in the last few years has therefore shown an increasing number of articles devoted to this subject. It is worthy of comment, however, that certainly in the majority of instances the diagnosis has been made by more or less indirect methods, such as the association of suspicious lesions with a positive Wassermann reaction, marked deformities of the stomach as revealed by the X-ray but without the corresponding cachexia and anæmia of carcinoma, and other indirect evidence. So far as I have been able to discover from the literature, in not a single case of gastric syphilis have the spirochætes been found. Symmers,⁴ in 1916, in reporting a case of syphilitic ulcer of the stomach in which death occurred from hæmatemesis, stated that Pappenheimer and Woodruff were able to find only twelve other acceptable cases of syphilitic gastric ulcer in the literature. In the case of Symmers the diagnosis was made at autopsy by the finding of multiple ulcers of the stomach which microscopically showed miliary gummas, endarteritis obliterans, and circumvascular plasma and round-cell infiltration.

The diagnosis of gastric syphilis will not be discussed extensively in this article. Excellent accounts of the diagnosis have been given by Mills⁵ and by Eusterman.⁶ Instead emphasis will be placed here on the treatment of the surgical complications, of which the most commonly recognized are pyloric stenosis and hour-glass formation. Apparently, however, any of the sequelæ of ordinary peptic ulcer may occur also with the syphilitic ulcer. Perforation has already been noted above in the cases of Fraenkel and Flexner. Severe hemorrhage has also been known to occur. Except for the acute complications, such as perforation or hemorrhage, the conditions which have called for surgical intervention have usually represented the final stage of healing

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and have therefore been concerned with the results of scar formation. It is not surprising then that the most common indications for operation would be stenosis of the pylorus, hour-glass formation, or other conditions due to perigastric adhesions, etc. The process is of course analogous to the syphilitic strictures of the rectum. It is also not surprising that the search for spirochaetes has so far been futile.

A search of the literature shows that an operation has been performed for gastric syphilis on thirty-two patients. In many of these cases the diagnosis



FIG. 1.—Case III. Resected pyloric portion of stomach split open on side of lesser curvature to show tumor obstructing lumen. The hypertrophied muscle is clearly shown.

has been merely clinical and in others it has been supplemented by a microscopical examination of excised tissue. Of the reported cases, gastro-enterostomy has been performed in seventeen instances and resection of the pylorus in four instances. Eusterman,⁷ in reporting cases from the Mayo Clinic, states that ten operations were performed but he does not state the kind

of operation; it is evident from his article, however, that some of them were pyloric resections. In the accompanying table are shown the results reported by various authors after either gastro-enterostomy or resection of the pylorus. The results are difficult to interpret accurately because in many cases the data are unsatisfactory. In general, however, they show marked improvement. There have been only two deaths, one from nephritis and one on the third post-operative day in a case which presented numerous small ulcers in the duodenum. With the exception of the series of eight cases of Castex in which gastro-enterostomy was done with no permanent relief of symptoms, almost equally good results have occurred regardless of whether a resection or merely a gastro-enterostomy has been done. It should be stated that Castex performed gastro-enterostomy not only in cases in which evidence of pyloric stenosis existed, but also in some in which merely an ulcer of the stomach or duodenum was present which had been diagnosed clinically as syphilis. On the basis of these results Castex suggests that gastric or duo-

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denal ulcers whose symptoms do not disappear after gastro-enterostomy should be regarded as syphilitic and placed on specific treatment. It is doubtful, however, how many of such cases should be regarded as definitely syphilitic. It would seem that in cases of outspoken pyloric stenosis, no matter from what cause, surgical intervention would certainly give relief. On the other hand, many cases of syphilitic pyloric stenosis, even of high grade, have been entirely relieved of symptoms after a course of anti-syphilitic treatment. See in this connection articles by Eusterman, Beclere and Bensaude, Fowler, Hausmann, etc.

The difficulty of accurate diagnosis makes any analysis of results somewhat unsatisfactory, since cases which are regarded by some as syphilitic would doubtless be considered as questionably syphilitic by others. Again, also the



FIG. 2.—Case III. Longitudinal section of pyloric portion and tumor.

pathology is not accurately described, so that it is uncertain whether the condition for which operation was undertaken was an actual pyloric stenosis, active ulcer of the stomach, or some other condition. Of the three cases of apparently definite syphilis of the stomach upon which I have operated, two presented a type of lesion which has received but little comment and for the treatment of which there have been reported so few observations that apparently no good precedent has been established. These are the cases in which there is moderate thickening of the whole stomach which is reduced in size, an absence of pyloric stenosis and an absence of any gross deformity such as hour-glass formation or extensive perigastric adhesions. The symptoms may be very distressing and consist of vomiting, pain, loss of weight, etc. It has been chiefly from a desire to arouse discussion and to profit by the experience of others that I report these cases.

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CASE I.—White woman, aged thirty-one. Admitted to Barnes Hospital, October, 1920. Began to have vomiting eight years ago. Vomited immediately after eating, without nausea. In September, 1919, had large hæmatemesis of brown clotted blood. Again in November of same year had large hæmatemesis and was thought to be dead. Has lost 80 pounds since origin of trouble. Has had three miscarriages. Examination showed secondary anæmia, Wassermann four plus, perforated nasal septum, no free HCl in stomach. X-ray by Doctor Mills showed moderate delay in emptying of stomach, with deformity of pylorus, with possibly syphilitic ulcer (serpiginous) of pylorus. Previous antisyphilitic treatment for four months with both salvarsan and mercury resulted in improvement



FIG. 3.—Case III. Section through tumor showing structure resembling a miliary gumma at point marked A.

of symptoms but without complete recovery. On October 20, 1920, a laparotomy was performed. Stomach found smaller than normal. Pylorus readily admitted finger. No enlarged glands. No perigastric adhesions. Slight thickening of whole stomach but no localized induration and no definite evidence of ulcer. No evidence of carcinoma. Duodenum normal in first portion. Liver normal. Gall-bladder slightly thickened but no stones or adhesions. Because of absence of definite evidence of organic pyloric stenosis or of active ulcer no operative procedure was undertaken on the stomach except to remove a small piece of the anterior wall for microscopic examination. A microscopic examination of the removed piece showed the mucosa slightly thinner than normal. The whole of its outer border was densely infiltrated with small medium-sized mononuclear cells. Typical polyblasts, few plasma cells and a few polymorphonuclear cells were in this infiltration. A similar infiltration was seen focally in the lower portion of the mucosa. There were a few mononuclears in the wall of the endothelial-lined spaces in the serosa. A diagnosis was made of chronic atrophic gastritis, probably syphilitic.

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The patient was again placed on antisyphilitic treatment. About six months after leaving the hospital she died, following an abortion. Death was presumably due to infection.

CASE II.—Colored man, aged twenty-four, Pullman porter. Entered Barnes Hospital, May 16, 1921. Onset October, 1917, with choking sensations in throat and palpitation with precordial pain. Vomited food eaten on same day. Course progressively worse so that at times fasting was necessary for several days. To relieve feeling of distention, induced vomiting brought up bloody material with food. Pain in epigastrium sometimes but not always relieved by food. Constipated. Salts every day. Lost 17 pounds in last 6 months. Examination showed mass in epigastrium. Free HCl 26; total acid 40. Wassermann negative

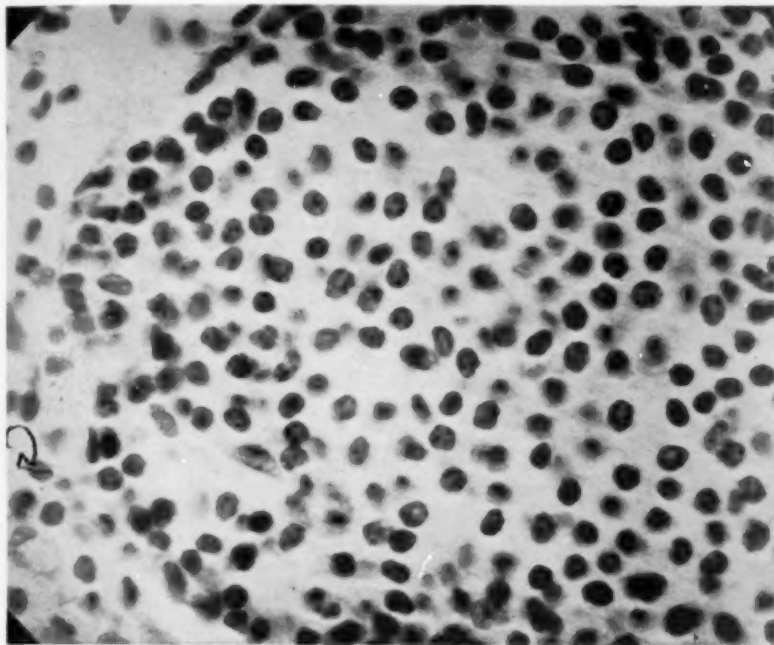


FIG. 4.—Same as Fig. 3, showing character of cells in the small gumma.

in both blood and spinal fluid. Hæmoglobin 80 per cent., leucocytes 7200, erythrocytes 5,160,000. X-ray (Doctor Larimore and Doctor Mills) showed superficial lesions involving distal portion of pars pylorica of type suggesting luetic ulceration. Stomach empty at five and one-half hours. On May 23rd laparotomy. Stomach found somewhat smaller than normal. Moderate thickening of pylorus, but nothing definitely indicative of ulcer. No enlarged glands. Liver normal. Posterior gastro-enterostomy with no loop done, and appendectomy. The stoma was about two inches in diameter. Piece of stomach wall next to gastro-enterostomy opening showed infiltration of all coats of stomach with round cells which were not, however, limited to blood-vessels. Uneventful recovery. X-ray examination (Doctor Mills and Doctor Larimore) on September 18, 1921 (4 months later) showed good function of gastro-enterostomy but no marked change in appearance of lesion. Patient's condition much improved with gain of about 15 pounds in weight but there was still some epigastric discomfort and fulness. In April, 1922 (about one year later), at another examination it was found that

about the same condition persisted. Gastro-enterostomy opening still patent but patient still complaining of discomfort almost immediately after eating. The beneficial result of the operation, although definite, has not been striking. Possibly, in view of the negative Wassermann reaction, this case should not be regarded as positively one of syphilis, but yet the other findings seemed to accord with that diagnosis.

CASE III.—Definite pyloric obstruction. Colored woman, aged forty. Entered Barnes Hospital, April 29, 1921. Symptoms of epigastric discomfort for about 16 years. For last four months there has been vomiting after every meal. Constant throbbing pain in left upper quadrant. Loss of weight of 35 pounds. Sometimes

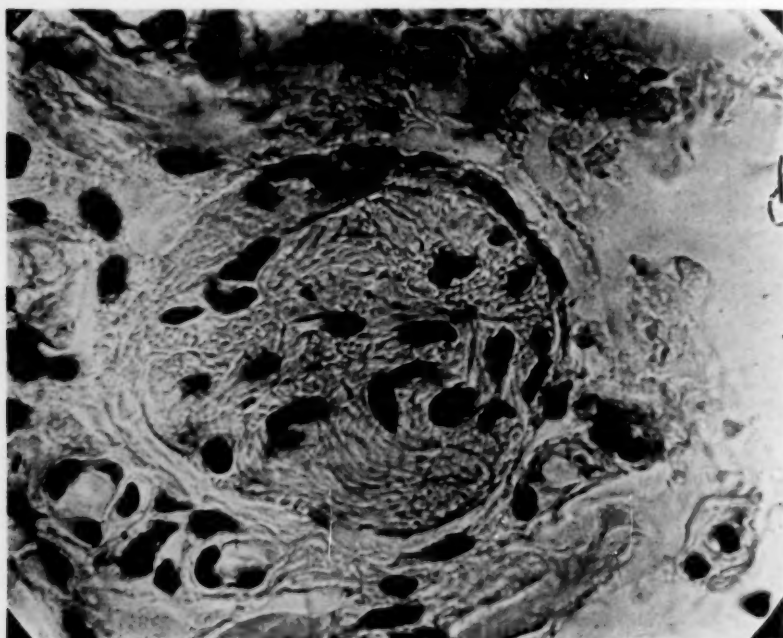


FIG. 5.—Same specimen as Fig. 3, but showing obliterating endarteritis.

vomits food eaten on previous day. Three miscarriages. Wassermann four plus. Free HCl varied from 3 to 6. Visible peristalsis in stomach. Hæmoglobin, 70 per cent., reds, 3,420,000; leucocytes, 11,000. X-ray (Doctor Mills and Doctor Larimore), lesion of pars pylorica, probably luetic. Small residue in stomach at 24 hours. On May 10, 1921, laparotomy was performed. Stomach about normal size despite pyloric obstruction. In pyloric region a definite tumor could be felt about the size of a hickory nut. This was slightly movable within the stomach and felt somewhat like an adenoma. It was definitely limited to the interior of the stomach, and there was no change in the gross appearance of the outer layers of the stomach suggestive of a carcinoma. There were no enlarged glands. The stomach was opened to inspect the tumor, which was found nearly obstructing the pyloric orifice and arising from the greater curvature side of the stomach. It was covered with mucosa. A resection of the pylorus was done followed by a gastro-jejunostomy by the Polya-Balfour method. Uneventful recovery. X-ray examination (Doctor Mills) two weeks later showed "admirable conditions after gastric resection and gastro-jejunostomy." Antisyphilitic treatment was also instituted.

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A report from the patient was received on April 12, 1922 (11 months after the operation), which stated that she was entirely relieved of her symptoms, that she had gained markedly in weight and that she was eating a general diet.

Microscopic examination of the tumor showed numerous small gumma-like collections of round cells beneath the mucosa. There was very marked perivascular infiltration with thickening of the intima of some of the arteries. There were occasional small areas of necrosis. These collections of cells were seen in the muscular layers as well as in the submucosa. Doctor Opie, who examined several of the sections, expressed the opinion that they presented very striking evidence of syphilis. Levaditi stains, however, failed to reveal spirochaetes.

TABLE I

Results of Surgical Treatment in Gastric Syphilis.

Author	Gastro-enterostomy	Resection	Result
Mills ¹⁰	One case	.....	Marked improvement
Downes and Le Wald ¹¹	Five cases	.....	4 well, 1 died of nephritis
Hubbard ¹²	One case	.....	Well
McNeil ¹³ .....	.....	One case	Good
Mühlmann ¹⁴	One case	.....	Excellent
Culler ¹⁵ .....	.....	One case	Fair
Douglas ¹⁶ .....	.....	One case	Excellent
Eusterman ⁶	10 operations but types not specified	.....	3 "cured", 5 much improved 2 not heard from
Dasso ¹⁷	One case	.....	Well
Beck ¹⁸ .....	.....	One case	Well
Castex ¹⁹	Eight cases	.....	Symptoms returned in all cases.
Sparmann ²⁰	One case	.....	Death on third day. Numer- ous small ulcers in duo- denum.
Graham	One case	One case	Resection case well. Gastro- enterostomy case improved.

Another type of lesion which is possibly syphilitic is the gastric or duodenal ulcer associated with so-called gastric crises in tabes dorsalis. A recent case of moderately advanced tabes came to the hospital with attacks of vomiting and marked epigastric pain. The patient was supposed to be suffering from a gastric crisis. An X-ray examination by Doctor Mills disclosed a duodenal ulcer with a residue in the stomach after twenty-four hours. A posterior gastro-enterostomy was done, followed by complete relief of the gastric symptoms, and a gain of thirty-five pounds in weight. Vigorous anti-syphilitic treatment was instituted after the operation. There was nothing either in the findings at the X-ray examination or at operation to suggest particularly a syphilitic origin of the ulcer, and it is possible that there is no good reason to assume anything more than a coincidental relationship.

In conclusion, it should be stated that surgical complications of gastric syphilis occur with probably greater frequency than is commonly recognized. These consist usually of deformities produced by scar tissue formation in the healing of the syphilitic process. They are commonly seen, therefore, as stenoses at or near the pylorus, but sometimes as hour-glass contractures or perigastric adhesions. In another group in which there is impaired motility

without organic stenosis of the pyloric orifice but with rather generalized sclerosis of the whole stomach, it is doubtful how much good, if any, can be accomplished by surgical measures. In a study of thirty-four cases (including thirty-two from the literature and two from the author's series) resection of the pylorus gave uniformly good results in cases of stenosis of that orifice, while gastro-enterostomy was frequently followed by only slight or temporary improvement. It would seem, therefore, that pylorotomy is more likely to be followed by complete relief of symptoms than is simple gastro-enterostomy, although a study of more cases may show that the latter operation is sufficient in cases of actual stenosis of the pylorus. There will remain certain cases without organic obstruction in which surgical measures will probably not be indicated.

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LATE RESULTS OF GASTRO-ENTEROSTOMY FOR GASTRIC
AND DUODENAL ULCERS, INCLUDING ACUTE
PERFORATED ULCERS*

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It appears to be the general impression, especially among medical men, that a relatively large number of patients suffer as much after a gastro-enterostomy as before the operation. Yet the proportion of unsuccessful cases from the standpoint of ultimate results seems always to be a matter of impression rather than of fact. An effort to estimate the relative frequency of the poor late results and to determine some of their causes is the object of this paper. Three explanations of the failures immediately suggest themselves: first, that the operation was improperly performed in the unsuccessful cases; second, that the operation was wrongly elected in these cases; third, that gastrojejunostomy is inevitably and inexplicably unsuccessful in a certain proportion of cases.

Technical errors dependent upon such features as the size and situation of stoma, length of loop, type of suture material and imperfect approximation of the mucous membrane edges are undoubtedly responsible for the poor late results in some cases, as will be noted in connection with the fluoroscopic examinations; yet the operation in recent years has been so nearly standardized that these factors probably are responsible for only a relatively small proportion of failures.

The question arises then as to why some gastro-enterostomies, presumably performed in a proper manner, should prove unsuccessful. We have sought an answer through a review of the late results in a consecutive series of cases performed by one of us at the New York Hospital from April, 1914, to 1922. During that period accurate records were kept as to the operative findings, especially the site of the ulcer. In a previous article † the cases from January, 1912, to April, 1921, were presented, but those prior to April, 1914, have been omitted from this series because in some of the early records the site of the ulcer is not stated.

There were seventy cases of posterior gastro-enterostomy for ulcers of stomach or duodenum. In a small proportion something in addition to the gastro-enterostomy was done. The operation was always the short loop type with suture, clamps being employed. Linen was used as the outer layer in about 25 per cent. of the cases. Two of the series developed gastrojejunal

* Read before the American Surgical Association, May 2, 1922.

† Journal Medical Society, State of New Jersey, vol. xviii, 1921, p. 214.

ulcers, one with the linen suture showing on the floor of the ulcer. In recent years chronic gut has been employed exclusively. No rule has been followed as to the direction of the stoma, but it has been made to conform as nearly as possible to the apparent direction of the first part of the jejunum, deviating somewhat from the vertical to the right or left.

Of the seventy cases seventeen were gastric, fifty duodenal; in three, which may be termed "parapyloric," it was not determined whether the ulcer was gastric or duodenal.

The mortality was six. Four occurred in duodenal ulcers and two in gastric. In five, gastro-enterostomy only was done; in one pylorotomy. The deaths were due to delirium tremens, mastoiditis with septicæmia, death on twenty-fifth day, peritonitis, pulmonary embolus, intestinal obstruction; unexplained in one dying on fifth day, although an autopsy was performed.

Sixty-four patients were discharged from the hospital and sixty have been traced, or 93 $\frac{3}{4}$ per cent. One of the patients was killed shortly after leaving the hospital, consequently only fifty-nine cases are reported. These cases have been followed for varying lengths of time. One followed over seven years; ten between six and seven years; four between five and six years; seven between four and five years; two between three and four years; eight between two and three years; seventeen between one and two years; ten less than one year. The average time was about three years.

In following these patients particular consideration has been given to the general physical condition, weight, appetite, digestion, bowels, gastric analysis and fluoroscopic examination of the stomach. Such features as pain, feeling of distention, eructation, nausea, vomiting and diarrhœa have been carefully inquired into.

Of the fifty-nine cases traced, forty-two have been fluoroscoped by Doctors Holland and Dineen. The patients come to the hospital at 10 A.M., having taken a cathartic the night before and fasted since midnight. The fasting contents are expressed, the large stomach tube being used, as the duodenal tube slips too easily through the gastro-enterostomy stoma. A test meal is then given, expressed and analyzed. A liquid lunch is taken at noon and the patient is fluoroscoped at 4 P.M. In the examination the screen is quickly passed over the heart, lungs and abdomen, and then the patient is given the first glass of barium. The second glass is given later when by pressure an effort is made to cut off the gastro-enterostomy stoma, so that the pylorus can be studied. The fluoroscopic examinations are made in the upright position and therefore the conditions more nearly approximate those which prevail after taking food than examinations made when the patient is recumbent. The fluoroscopic observation of the stomach in action likewise would appear to give more exact knowledge than X-ray plates which register momentary phases. Twenty-four of the forty-two cases fluoroscoped ‡ had

‡ We have disregarded associated operations on gall-bladder, appendix etc.

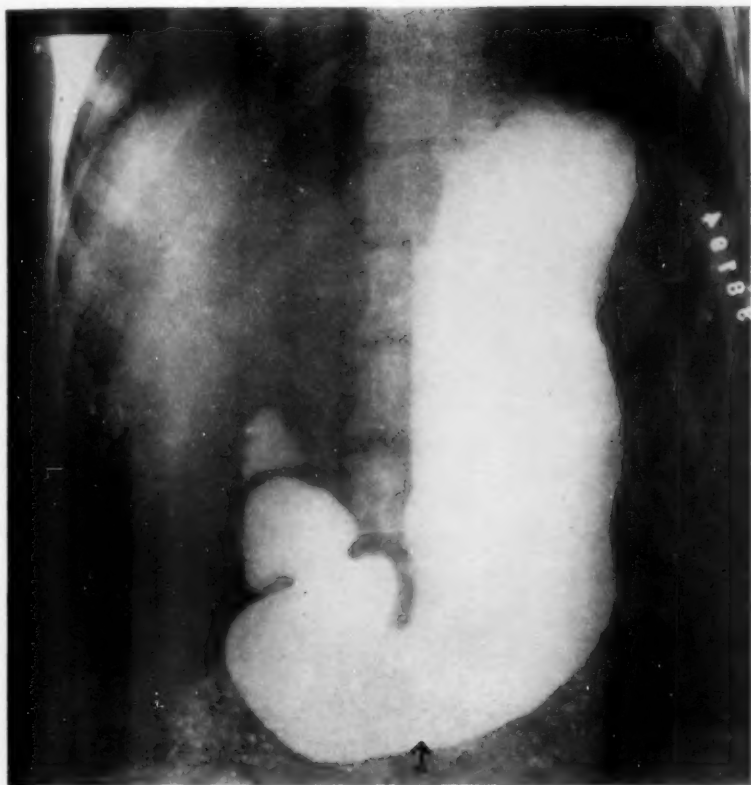
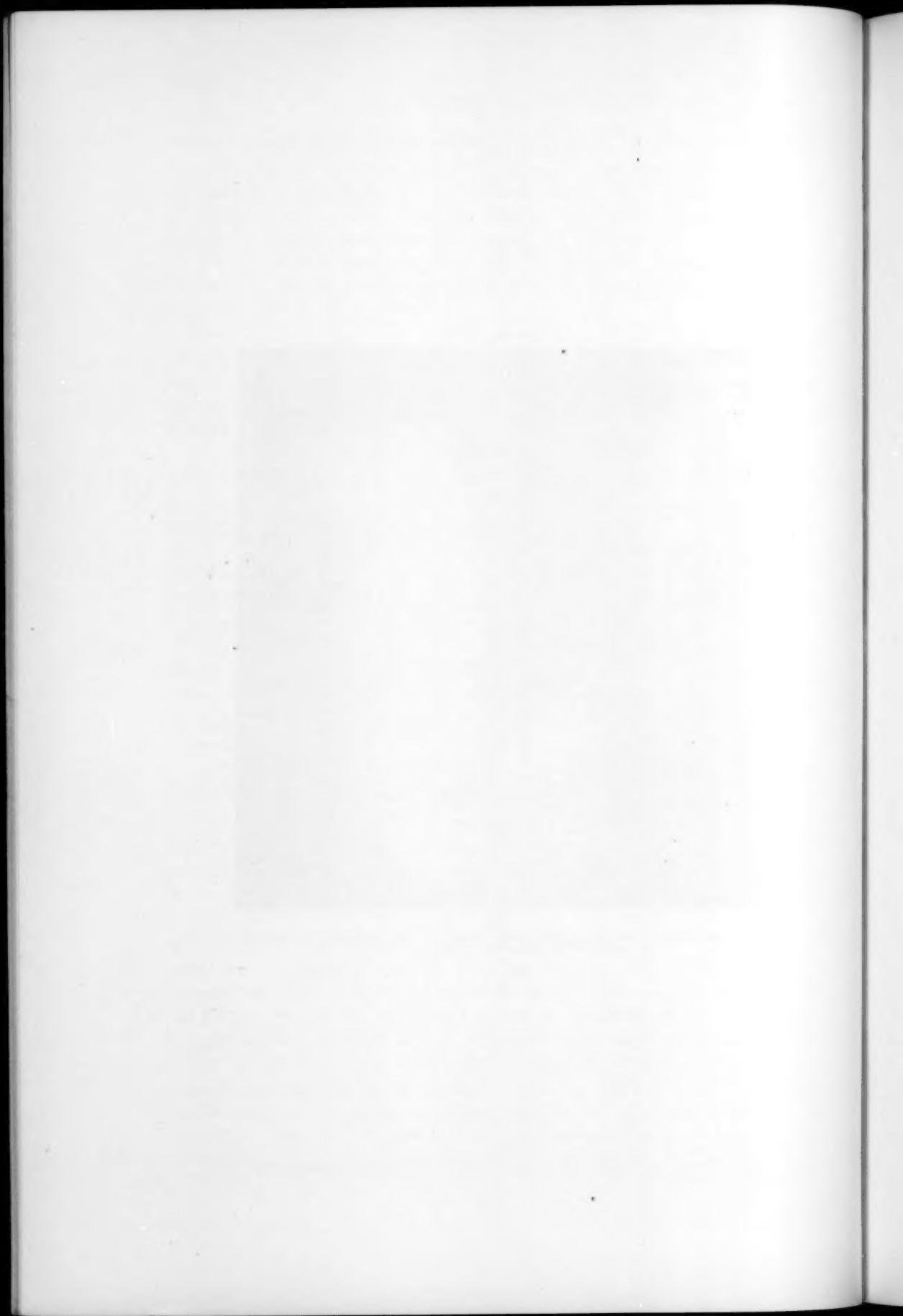


FIG. 1.—Situation for properly placed stoma, its position corresponding to downward prolongation of vertical portion of lesser curvature.



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only a posterior gastro-enterostomy performed and showed good results, and in these cases the following features were noted:

1. The stoma regularly was at the most dependent portion of the stomach just to the left of the midline, its situation corresponding to the downward prolongation of the vertical portion of the lesser curvature (Fig. 1). A stoma in this position empties the stomach efficiently and quickly.

2. There was diminished gastric peristalsis.

3. The barium immediately began to pass out by way of the gastro-enterostomy opening. -

4. The pylorus was patent under pressure. In most of the cases no barium passed the pylorus except under pressure. In a few, small amounts passed spontaneously. Our findings differ in this respect from those of most observers.

5. It averaged about twenty-five minutes for all the barium to leave the stomach.

6. In none of the cases did the stoma close.

The above observations present the conditions which we noted in satisfactory cases.

Examination of those cases in which the pylorus had been occluded by kangaroo tendon tied around it, as well as those in which the ulcer had been inverted or the pylorus narrowed with sutures, ultimately showed the pylorus open to the extent that barium could be forced through under pressure. Fluoroscopic examination of those cases in which the pylorus has been divided revealed a pouch at the pylorus, with a well-functioning gastro-enterostomy.

The results of gastric analyses will not be reported since our findings coincide with those of Patterson and others who have shown that a diminished acidity is the rule.

A. L. Holland has kindly prepared the following analysis of fluoroscopic findings after gastro-enterostomy based on the study of a large number of cases by various operators. He has thus had opportunities to observe a considerable number of patients who were not cured. His findings in these are of interest.

1. In the apparently cured cases the fluoroscope usually shows a stomach of slightly less tone than before the operation, the stoma placed in the most dependent position, the opening being sufficiently wide to allow a fairly good-sized stream of opaque material to pass into the jejunum, but not so wide as to drain the organ at once. In these cases the antrum and first portion of the duodenum (cap) can usually be filled out with the opaque material but only under prolonged pressure and manipulation. In these cases the first portion of duodenum usually does not fill spontaneously, at least during the ordinary fluoroscopic observations.

2. In those cases that have been only partly relieved of their ulcer symptoms, the fluoroscope may show conditions to be ideal, as described in the preceding group, but in most of them the stoma has not been placed in the most dependent position or is too far to the left, or too near the antrum, or too small, or even not patent. A stoma placed too far to the left seems especially bad. Frequently

in such cases a small residue is left in the most dependent portion of the stomach. This seems to act as an irritant, causing spasm of the pars pylorica, hence the continuance of the ulcer syndrome.

3. In those cases of the third class (the failures) the stoma may be absent at the fluoroscopic observation or too small or not placed in the dependent portion, as described in the preceding group. In not a few the conditions observed fluoroscopically would seem to be ideal. In such cases one is justified in suspecting a marginal ulcer; but here the symptoms are apt to be somewhat different from the original symptoms complained of before the operation.

4. A large percentage of those cases that present symptoms of irregular type can probably be called post-operative or secondary neuroses. In perhaps a large majority the conditions fluoroscopically observed are ideal. In a small percentage the stoma has been found so large that the stomach has drained immediately. This has probably resulted in an intestinal indigestion which has caused the irregular symptoms such as loose bowel movements and gas pressure in the abdomen. In several such cases the loop seemed to be unusually long.

Holland believes that pain is the most reliable evidence of ulcer activity, and is dependent upon increase in tension in the zone of the ulcer. This increase in intragastric tension is made evident by the character of the peristalsis and the general tone of the organ. In the early cases, the increase in peristaltic activity and tension tends to overcome any obstruction and a residue is thus prevented but sooner or later as decompensation becomes established a residue is inevitable. The first effect of a gastro-enterostomy is the lowering of the tension throughout the stomach, in this manner preventing undue peristaltic activity in the parts adjacent to the ulcer. And this would seem to be upheld by the fluoroscopic study of such cases, as the tension, and therefore the peristaltic activity, in the satisfactory cases seems always to be considerably less after the operation.

In those cases where the results have been so satisfactory one can frequently detect considerable tension, particularly in the antrum and pars pylorica, due either to the irritation of a residue or the efforts of the stomach to propel the chyme through a small stoma.

Good results in this operation do not seem to depend upon the complete occlusion of the pylorus, as in practically all cases the antrum and duodenum (cap) can be filled under pressure. But where the opaque chyme tends to pass through the pyloric exit rather than the stoma, the results are usually not lastingly satisfactory. When the barium passes through the pylorus, in unsatisfactory cases at times reverse peristalsis or other erratic behavior may be noted in duodenum. In these cases a slight kinking at the side of the stoma may not bring about a serious obstruction but yet be sufficient to produce gastrointestinal symptoms of a pronounced character, and occurring with definite relation to meals they may easily be mistaken for the recurrence of an ulcer.

Late Results.—Of the fifty-nine patients followed, fifty were well at the last report and experienced no discomfort or untoward symptoms. In recent years we have appreciated the importance of after-treatment and have urged a routine life and diet and medical supervision for a long period. The observance of this precaution appears to have improved the results.

The patients are instructed to take small meals frequently, so as not to have the upper intestinal tract unduly filled at any time nor empty for long periods. Therefore, instead of three large meals daily, they follow a routine

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somewhat as follows: 8 A.M. breakfast; 10 A.M. milk and crackers; noon lunch; 4 P.M. milk and bread; 7 P.M. dinner; 10 P.M. milk and crackers or 5i sodium bicarbonate in glass of warm water.

A diet slip is given the patients but the diet is not restricted to a marked degree. The patients, however, are particularly instructed to avoid the following: Alcohol; foods fried in grease, which are not readily digested; condiments, beef extracts, and such things which unduly stimulate gastric secretion. It is explained to the patients that since the food is only in the stomach for a brief period, it should be slowly and thoroughly masticated. A glass of warm water with 5i sodium bicarbonate should be taken before retiring.

Nine of the cases have been reported as unsatisfactory, two of these presenting gastrojejunal ulcers. It is of interest to note that we have had in this same period three other marginal ulcers in cases originally operated upon elsewhere.

The employment of gastro-enterostomy for gastric ulcer need not be discussed at length since it is generally accepted that this operation alone should be elected in gastric ulcers only for the relief of obstruction. Such ulcers should, if feasible, be removed, in conjunction with which gastro-enterostomy is often advisable.

There were seventeen cases, nine within two inches of pylorus and six at a distance of more than two inches. There were two operative deaths (one gastro-enterostomy, one pylorotomy). Gastro-enterostomy alone was done in eight patients whose condition did not seem to warrant more radical measures. One died of intestinal obstruction; five showed ante-operative retention of six hours or more, and gave good results. The two without retention showed one poor result and one unknown. The other nine cases had gastro-enterostomy plus some other procedure, as removal of ulcer in three, all good results, followed three to five years; partial gastrectomy six, one died of peritonitis, three gave good results two to six years, two later developed pulmonary tuberculosis. The gastric cases are so few that no deductions can be drawn; it is of interest, however, that the five cases with definite retention have done well after gastrojejunostomy alone, one for six years; two for four years; two for one and a half years.

In duodenal ulcers the indications for removing the ulcer are far less striking and gastro-enterostomy as the sole or principal feature of treatment must be considered. Some surgeons appear to employ it as routine, others decry it for most cases. While it is evident that the large proportion of patients are cured by the operation, some cases in which the procedure has been employed are symptomatic failures. Efforts should be directed to the determination of what proportion of cases are successful and if possible what types of cases fail to be benefited. If these questions could be answered, definite indications might be laid down as to when the operation should be employed and when avoided.

There were fifty cases of duodenal ulcer with six unfavorable late results. In thirty-two, gastro-enterostomy only was performed with two poor results.

CASE I. Male, forty, April, 1917, very weak, repeated vomiting of blood, hæmoglobin 36; transfusion, no X-ray; gastro-enterostomy. No ulcer recognized. Well for two years, then had a severe hemorrhage. Fluoroscopic examination indicates a duodenal ulcer, but patient refuses operation. Digestion and general health have been good.

CASE II. Woman, forty, December, 1921, symptoms and X-ray suggestive of duodenal ulcer, four-hour residue but no six-hour retention. Operation. Gall-bladder contained stones, cholecystectomy; first part of duodenum covered by dense adhesion; induration in wall of duodenum suggested ulcer but this was not positively established gastro-enterostomy. Now has occasional attacks of vomiting. Fluoroscopic examination shows stoma functioning well. Operation was so recent (4 months) that the ultimate result is somewhat uncertain.

In nine gastro-enterostomy plus inversion of ulcer; one poor result.

CASE III. Male, forty-one, indurated duodenal ulcer found at operation, no six-hour retention by X-ray. Well for two years after operation, since then has had pain in epigastrium beginning about three hours after meals; nausea; food or bicarbonate relieve pain. Has lost 10 pounds.

In one gastro-enterostomy plus excision of ulcer.

In three gastro-enterostomy plus ligation of pylorus with kangaroo tendon. Two poor results.

CASE IV. Male, forty-three, April, 1915, developed recurrent gastrojejunal ulcers. The stoma was twice reconstructed with excision of ulcer. Such recurrences apparently are not rare and therefore it appears best in such cases to disconnect the stoma entirely, doing a pyloroplasty if pylorus is stenosed or ulcer unhealed.

CASE V. Male, thirty-one, March, 1916, no six-hour retention. Recurrence of same symptoms as before operation; much epigastric pain, nausea, and vomiting after meals. Explored by another surgeon seven months after operation, stoma found patent, adhesions freed, well for six months then recurrence of all symptoms.

In four, gastro-enterostomy plus section of pylorus (von Eiselsberg), one poor result.

CASE VI. Emaciated young woman. Gastric symptoms relieved but diarrhœa has persisted for the seven years and requires morphine.

In one, gastro-enterostomy plus infolding of pylorus by suture.

The last three procedures were employed only in the early cases of the series.

Forty-five of the fifty unquestionable ulcers. Five belonged to that perplexing type with ill-marked, outward and visible signs of ulcer on exposure of duodenum, and although it was believed on the basis of the operative findings that an ulcer was present, this was not positively established. It is

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notable that of the six cases reported above as poor results, four belonged to this group, the fifth has not been traced. Four of the five were done in the first two years of the series—that is, before 1916. The importance of avoiding an unnecessary gastro-enterostomy is such that in recent years it has been our practice to open the duodenum for exploration in such doubtful cases to prove or disprove the existence of an ulcer. It is almost universally agreed that a gastrojejunostomy in the absence of obstruction should never be done unless there is definite proof of an ulcer. By an exploratory incision into duodenum unnecessary gastro-enterostomies have been avoided in a number of our cases. In only one case, however, has a doubtful ulcer been verified by incision. Yet, in some cases microscopic examination of the tissue removed from a suspected area has revealed the duodenitis described by Judd.

In a previous analysis (*l. c.*) we found 18 per cent. failures in forty cases of parapyloric ulcers, that is those close to pylorus, which had been treated by gastrojejunostomy. The duodenal and gastric were not differentiated. We found that all of those which showed six-hour barium retention before operation were successful; whereas in those without six-hour retention there were 33 per cent. failures after gastro-enterostomy.

In the present series of duodenal ulcers the failures are so few that figures bearing upon this phase cannot be presented without unduly exaggerating the importance of a very small number of cases. It is significant, however, that at no time have we had a case presenting six-hour retention before operation which gave an unsatisfactory late result, whereas of the six unsatisfactory results four occurred in the fifteen cases in which there is a definite statement as to the absence of six-hour barium retention. In the other two there was no six-hour X-ray record.

Accumulated evidence indicates that a well-placed gastro-enterostomy is a fairly reliable procedure for the treatment of duodenal ulcer, but that unsatisfactory results may be expected to ensue in a small proportion of cases. Apart from the failures due to improperly placed stomas the reliability of the operation for permanent relief of the patient appears to be somewhat proportionate to the degree of pyloric stenosis. For this assumption the following explanation is suggested:

In many ulcers near the pylorus there develops some degree of pyloric obstruction which in part is due to cicatricial contracture and in part to pylorospasm. This narrowing of pylorus excites a more or less violent compensatory response from the gastric musculature to overcome the increased pyloric resistance. This is evidenced by increased peristalsis, which can be recognized fluoroscopically, and later by delayed emptying of the stomach. A six-hour retention, especially on several examinations, represents a fairly well-marked degree of this abnormal condition. Drainage by gastro-enterostomy immediately causes relief. Subsequent to operation little of the stomach contents pass through the pylorus, according to our fluoroscopic

observations, and conditions are established favorable for repair of a duodenal ulcer.

In cases without pyloric contracture or constriction, the immediate relief is often less marked. But here, too, almost the whole flow of gastric contents, when the stoma has been properly placed, is ordinarily through the stoma, moreover gastric peristalsis and intragastric tension are reduced, therefore conditions are favorable for the repair of the ulcer. The immediate results in both groups are usually satisfactory since a good stoma evacuates the stomach. But ultimately some of the cases do badly; those with a real organic stenosis extremely rarely, those with a fully patent pylorus occasionally. These ultimate failures constitute the feature which causes the most anxiety. They are evidently due in some cases to contraction of stoma, with passage of a considerable proportion of gastric contents through the pylorus. Recurrence of symptoms may then be due to an incompletely healed ulcer or to interference with the progress of the chyme from duodenum into jejunum by the hitching up or angulation of the jejunum at the stoma. This condition would probably not be prevented by any measure intended to block the pylorus except its division, which is not advisable; ligation and such measures exert only a temporary effect. These late disturbances can apparently be avoided only by a more careful selection of the cases appropriate for gastro-enterostomy.

SUMMARY

A well-placed gastro-enterostomy empties the whole stomach adequately and quickly. If fluoroscopic examination shows incomplete or tardy emptying a technical fault may ordinarily be inferred. Even a well-placed stoma occasionally is associated with serious sequelæ. First, there is always an appreciable risk of a gastrojejunal ulcer, variously stated as from 2 to 3 per cent. Second, symptomatic failures occasionally occur. In chronic indurated ulcers, especially those with some grade of pyloric obstruction, as represented by six-hour barium retention, symptomatic failures have not been experienced. The rare symptomatic failures apparently occur after gastro-enterostomies for small non-obstructing ulcers. It is our practice in all cases of suspected duodenal ulcer to determine before operation whether a six-hour barium retention is present. If such exists we feel that a gastrojejunostomy is unquestionably justifiable if an ulcer is found at operation. If no six-hour retention is noted, we endeavor to avoid a gastro-enterostomy, although this is not always done, especially in large indurated ulcers. If there is uncertainty after exposure of the duodenum as to the existence of an ulcer, the lumen is opened and the mucous membrane explored. When a small non-obstructing ulcer has been demonstrated, either with or without the aid of this exploratory incision into the duodenum, an appropriate plastic operation on pylorus or duodenum, if feasible, with excision of the ulcer, is elected in preference to a gastrojejunostomy.

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Acute Perforations.—The foregoing impressions in regard to gastrojejunostomy have a definite bearing upon an important factor in the treatment of acute perforated ulcer, namely whether a gastro-enterostomy should or should not be made at the initial operation. A brief analysis of our cases will explain this feature. The series comprises fifty-nine cases of acute perforated ulcers of stomach or duodenum for which we have been directly responsible either at New York or Hudson Street Hospitals since 1910. Some have been operated upon by our associates on the Second Surgical Division.

There were fifty-eight males and one female. The ages ranged from eighteen to sixty-five, but 90 per cent. were about equally distributed between the third, fourth and fifth decades of life. There was a mortality of eleven, seven from peritonitis, one from pneumonia, one from pulmonary embolus, one from multiple abscesses of the liver, and one from pelvic and subdiaphragmatic abscesses. The length of time between the perforation and the operation was of striking significance in the mortality. Thus, in forty cases operated upon within six hours after the perforation there were no deaths; there were four deaths in nine cases operated upon between six and twenty-two hours after perforation and seven deaths in nine cases operated later than twenty-two hours. In thirty-four (57 per cent.) of the patients there was a definite history of gastric symptoms for a period of one year or more. An incorrect diagnosis was made seven times; six times acute appendicitis; once cholecystitis. In all except three of the cases the perforation was on the anterior surface of the duodenum or stomach close to the pylorus.

A primary gastrojejunostomy was made in only nine of the cases. In these there appeared to be undue constriction of the pylorus after suture of the perforation. All were cases operated upon early and none died. In later cases the risk of obstruction was considered less than the danger of prolonging the operation by adding a gastrojejunostomy. Apparently none of the eleven deaths resulted from obstruction of the pylorus and analysis of the fatal cases fails to show any in which it is probable that gastro-enterostomy would have saved the patient. This throws doubt upon the necessity for the gastro-enterostomy in the nine cases in which it was elected, and likewise upon the contention that routine initial gastro-enterostomies will diminish the mortality.

Thirty-six of the patients have been followed for periods of one to six years, one additional patient for six months. This case was operated upon six months ago and at the initial operation a primary gastro-enterostomy was made; he developed a lung abscess for which he was recently operated. The result of the gastro-enterostomy is uncertain, therefore the case will not be included in the tables.

The late results in those followed who did not have a primary gastro-enterostomy show twenty-one out of thirty-one well and free from symptoms; ten had recurrence of gastric symptoms. Seven of these have been reoperated and a gastro-enterostomy done. They had developed pyloric obstruction with

gastric retention. Of the seven, six have been completely cured, one improved. The other three still have symptoms, but have had no further surgery.

The late results of those who had a primary gastro-enterostomy show three well and free from symptoms; two had recurrence of gastric symptoms; in four the result is unknown. Of the two failures, one developed a gastrojejunal ulcer and had a reconstruction of the stoma. He is now relatively well. The second has had attacks of nausea, eructations of gas and vomiting. The number of cases followed after primary gastro-enterostomy are so small that this group will not be considered in the conclusions, although two out of the five followed showed poor late results.

Our observations are not favorable to routine initial gastro-enterostomy for the following reasons:

Primary gastro-enterostomy, as performed by the average surgeon, probably increases somewhat the immediate operative risk; but its chief disadvantage is that it exposes the patient to the untoward sequelæ of gastro-enterostomy; that is, symptomatic disturbances and gastrojejunal ulcers. Symptomatic failures follow gastro-enterostomy for parapyloric ulcers in about 20 per cent. of the cases. Gastrojejunal ulcers have been variously reported as occurring in 2 to 3 per cent. of all cases.

Our figures indicate that two out of three cases do well after closure alone; that one in three cases after closure of the perforation only later develop pyloric obstruction. This demands operation. But a definitely indicated late gastro-enterostomy on one-third of the cases is preferable to subjecting all the cases to prophylactic gastrojejunostomies at the initial operation. Since two-thirds of the patients do well without a gastro-enterostomy these would be subjected unnecessarily to the possible dangers and discomforts of the operation, namely peptic ulcer and symptomatic gastric disturbances. Closure of perforation with care in placing the sutures so as to avoid undue obstruction of the pylorus appears to be the best general procedure. Gastrojejunostomy must, however, be employed in those infrequent cases in which there is evidently marked diminution of the lumen after suture of the perforation.

Post-operative therapy is most important, particularly diet and observation for a long period. With more care in the operative procedure and the proper regulation of these cases after operation, especially as to diet, the percentage of good results should be increased.

THE END RESULTS OF OPERATIONS FOR GASTRIC AND DUODENAL ULCER AND CANCER*

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OF CLEVELAND, OHIO

MY associates in the Cleveland Clinic and in the Lakeside surgical service have performed 761 operations upon the stomach and duodenum. In the early records we find that the data are too incomplete to be of value for statistical study. Furthermore as this is the first time that we have systematically addressed inquiries to these patients, we were disappointed to find how many could not in our first attempt be traced. As the Bureau of Statistical Research of the Cleveland Clinic will continue indefinitely, we expect the list of traced cases to be greatly augmented. We are able, however, to present the following data regarding 560 cases, including:

Carcinoma of the stomach	189 cases
Carcinoma of the duodenum	5 cases
Sarcoma of the stomach	2 cases
Ulcer of the stomach	159 cases
Ulcer of the duodenum	200 cases
Tumors of the stomach (undifferentiated)	5 cases
Total	560 cases

As to the immediate results of operation we find in our earlier series the mortality was formidably high, but that in our last 108 cases of gastro-enterostomy and resection we have adopted methods of management and of technic based on biophysical concepts elsewhere published, embracing in particular anticipatory intervention—that is, treatment and management to forestall danger—the indication being based on statistical probabilities rather than on established indication of the case in hand. This includes blood transfusion in advance; 5000 c.c. saline solution; analgesia in bad risks; hot packs to abdomen, as a result of which the protection of the patient is increased.

In this series of 108 operations there was a mortality rate of two and eight-tenths per cent. In simple gastro-enterostomy alone the mortality is under one per cent.

Among the 560 cases which are the subject of this study, 450 came to operation; and exploratory operations only were done in ninety-nine, the condition being found to be inoperable.

The operations employed in our total series have included: Eighty-one two-stage and temporizing operations, 302 gastro-enterostomies and forty-eight resections of the stomach.

In an effort to trace the later course of these cases it has been possible

* Read before the American Surgical Association, May 2, 1922.

GEORGE W. CRILE

to secure information regarding 325 patients. Among these, forty-nine deaths since discharge from the hospital have been reported, the length of life of those that have died is as follows:

CASES DYING AFTER LEAVING HOSPITAL

Carcinoma of the stomach—33 deaths.

Less than 1 year	23	(including 11 inoperable cases)
1-2 years	1	
3-5 years	2	
Not known	7	(including 3 inoperable cases)

Ulcer of the stomach—6 deaths.

Less than 1 year	2	
3-5 years	1	
Not known	3	(including 1 inoperable case)

Ulcer of the duodenum—10 deaths.

Less than 1 year	1	
More than 5 years	2	
Not known	7	(including 2 inoperable cases)

TABLE I

Living Cases after Operation for Duodenal and Gastric Cancer and Ulcer

	Under one year	One to two years	Two to three years	Three to five years	Over five years	Total
Carcinoma of the stomach ..	15	13	1		6. including 1 for 10 years 1 for 14 years 1 for 16 years 2 for 20 years	35
Carcinoma of the duodenum		1		1	1 for 10 years	3
Ulcer of the stomach.....	27	19	2	5	17 10 for from 5 to 10 years 7 for from 10 to 15 years	70
Ulcer of the duodenum....	62	27		2	27 23 for from 5 to 10 years 4 for from 10 to 12 years	119
(Length of life undesignated.....1)						

Attempts to elicit information bearing upon the subjective, comfort and the economic status are at best unsatisfactory unless the inquirer can person-

GASTRIC AND DUODENAL ULCER AND CANCER

ally see the patient. Questionnaires, however, will often bring out significant points.

A questionnaire was sent to all cases operated upon more than one year ago and sixty-six replies have been received.

Eighty-two per cent. have reported that their symptoms were relieved; eleven reporting present discomfort. Eighty-five per cent. stated that they were able to resume their normal occupation or normal daily routine in less than six months after operation. Sixty-five per cent. have not been under any treatment for "stomach trouble" since operation, while twenty-two state that they have received some post-operative treatment. Two report subsequent surgical treatment.

Of especial value is the definite report of a gain in weight of thirty-one patients, the gain varying from three to sixty-two pounds, with a gain of more than ten pounds in twenty-seven cases. Seven report a definite loss in weight.

Thirty-eight report their present state of health as "good"; twenty-five as "fair," while four admit "poor" health at the present time.

As to the choice of operation, no general rule can be adopted, as in each case the extent of the resection or the choice between an anterior or a posterior gastro-enterostomy, a Polya, a Moynihan, etc., depends upon the situation in the individual case. By present methods the operability is limited only by anatomic considerations. Division of the operation into successive seances with the interoperative periods employed for the restoration and increase of the patient's reserves extends the operability of all cases to include all but those in which the growth has extended beyond the possibility of anatomic removal and repair.

This is presented only as a preliminary and tentative report. The study of our past cases is still in progress. The results of a more complete study will be offered later.

Several impressions have been gained:

1. The operative mortality is now reasonably in hand.
2. The patient as a whole, no less than the local ulcer, should be considered—namely, focal infections; auto-intoxication; readjustment as to work and rest; habits of eating and type of food should be considered—that is to say, the patient as a whole should be considered.
3. Duodenal ulcers give better results than gastric.
4. Vicious cycle is no longer seen.
5. Peptic ulcer appears in proportion to the curative effect of the treatment. It is a part of the disease rather than a result of the operation.
6. In general, we believe that a Sippy routine should be first tried in the acute cases and if ten days or two weeks do not give definite improvement, then operation should not be delayed.

THE RESULTS OF THE OPERATIVE TREATMENT OF CASES OF CHRONIC GASTRIC AND DUODENAL ULCER AT THE MASSACHUSETTS GENERAL HOSPITAL CLINIC*

BY CHARLES L. SCUDDER, M.D.
OF BOSTON, MASS.

At the surgical clinic of the Massachusetts General Hospital, there are available for study the records of 310 chronic ulcers of the stomach and duodenum.

This is an important group of cases, because each case was studied by the special gastro-enterologic clinic of Dr. Henry F. Hewes, or by the medical house service under Dr. David Edsall, Dr. William H. Smith and Dr. F. T. Lord, and in some instances by both services and in all instances by the röntgenologic service of Dr. George Holmes. Operation was done in each instance by a former or present member of the surgical staff of the hospital. Each member of the staff is a member of this Association.

There is a total of 310 cases in which the evidences of a chronic indurated ulcer were definitely seen and demonstrated.

Gastric Ulcer Cases.—There were 171 gastric ulcers.

There were twelve post-operative deaths and six autopsies. An immediate mortality of 7.6 per cent. Causes of death:

	Cases
Pneumonia	4
Peritonitis	2
Hemorrhage	2
Septic parotitis	1
Embolism	1
Persistent vomiting	2

One with autopsy, bloody urine and casts; fatty liver, icterus; pyloroplasty.

One without autopsy; pylorotomy.

The remote results of operation upon these 171 cases are known in 108 cases.

The time elapsed after operation until the observation of the present condition is one year to sixteen years.

Ninety-nine cases out of the 108 were practically well.

Nine cases were having symptoms of dyspepsia or indigestion similar or somewhat similar to the old trouble.

* Read before the American Surgical Association, May 2, 1922.

GASTRIC AND DUODENAL ULCER

Among the ninety-nine well cases a few have reported that, attributable to error in diet, a little sour stomach or gas would bother, but it was corrected by attention to diet.

In other words, the distressing situation preceding operation had been eliminated. Continuous good health obtained.

	Cases
1 year	19
2 years	25
3 years	33
4 years	10
5 years	8
6 years	3
7 years	7
11 years	1
14 years	1
16 years	1
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Total	108

In this connection it is significant that these 108 individuals had suffered from dyspepsia and indigestion sufficiently severe to need constant or intermittent medical advice for years, averaging five to ten years.

In other words, this group of gastric ulcer cases is a group in which the clinical picture is a long and distressing one; in which the lesion demonstrated is typical of the old infected chronic indurated ulcer. A few of them had had severe hemorrhages; a few had a subacute or chronic perforation; many of them had disturbed motility of the gastric musculature; many of them had a disturbed chemistry of the stomach; in all of them the general health was affected by the pathology.

The operative procedures followed in the gastric cases were:

	Cases
Gastro-enterostomy	47
Excision alone	6
Excision and gastro-enterostomy	13
Cautery and gastro-enterostomy—Balfour	14
Sleeve resection	3
Gastrogastrostomy	1
Pyloroplasty	1
No plastic, division of adhesions	2
Partial gastrectomy	21
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Total	108

In more than half the cases an excision or partial gastrectomy was done, *i.e.*, a direct attack was made upon the ulcer.

Duodenal Ulcer Cases.—There were 139 duodenal ulcer cases.

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There were nine post-operative deaths; six per cent. mortality—immediate.
Causes of death:

	Cases
Pneumonia	1
Peritonitis	3
Hemorrhage	1
Embolism	2
Shock	1
Cardiac	1
Total	9

Three autopsies.

The remote results are known in ninety-four cases.

The time elapsed after operation is from one to ten years, as follows:

	Cases
1 year	24
2 years	23
3 years	25
4 years	12
5 years	4
6 years	2
7 years	3
10 years	1
Total	94

Eighty-eight cases out of the ninety-four were practically well.

Six cases had troubles of digestion without diet and were not completely relieved.

The operative procedure followed in the duodenal cases was infolding of the chronic ulcer and a posterior gastro-enterostomy, with a plastic of omentum to the peritoneal surface of the ulcer. Occasionally cauterization of the ulcer accompanied the gastrojejunostomy.

Summary.—One hundred and eight chronic gastric ulcer cases—ninety-nine cases well, 91.7 per cent.; nine cases not well.

Ninety-four duodenal ulcer cases—eighty-eight cases well, 93.6 per cent.; six cases not well.

General mortality of the whole group, 310 cases, 6.7 per cent.

This group of cases is a general hospital group. None of the cases occurring in the private clinics of the surgeons operating upon this group are included here.

PEPTIC ULCER*

BY JOHN B. DEEVER, M.D.
OF PHILADELPHIA

PEPTIC ulcer continues to demand the attention of internist and surgeon alike, to say nothing of the victims of this annoying and debilitating condition. It is gratifying, however, to be able to record that surgery continues to offer the only prospect of a cure in an ever-increasing number of cases. Of a group of 600 cases, fifty of which, recently followed at the Lankenau Hospital, we learn that complete cures were obtained in eighty per cent., that is, entire relief of symptoms without any signs of recurrence. Some of these patients were operated upon as many as sixteen years ago. The majority, however, were operated since that time.

There is also a class, comprising about sixteen per cent. of the cases, who are markedly benefited by operation, although still suffering from an occasional attack of some more or less severe gastric disturbance but who frankly state that these attacks are entirely controllable by proper attention to diet, to hygienic and regular modes of life. Taking the above two classes together, it may be said that ninety-four per cent. of the cases under consideration have been decidedly benefited by operation. This leaves the comparatively small number of six per cent. who fail to be relieved by surgery.

The most common cause for the recurrence of ulcer symptoms is marginal ulcer or the development of a new ulcer. As to marginal ulcer, I believe it is the general experience that the unpleasant sequel is to be expected to take place in from one to two per cent. of operated cases. Diathesis seems to play a part in the development of marginal ulcer, since I have observed that it usually occurs in patients who, before operation, presented a very high free as well as a very high total acidity. It is in these cases that persistent post-operative treatment is particularly indicated. I have had the experience of having one patient return three times for the relief of marginal ulcer.

Diathesis also seems to be a factor in the persistence of ulcer symptoms after operation. But very often it may be due to some focus of infection residing more particularly in the gall-bladder or in the appendix. The following is a typical instance.

The patient (No. 3550/20) was operated upon at the Lankenau Hospital October 28, 1918, for ulcer symptoms of twenty years' standing. At the operation an ulcer was found at the fundus of the stomach and excised through an anterior gastrotomy. No other pathology was noted and no other operation was done at this time. The patient remained well for two years, following which the ulcer symptoms returned, accompanied by marked loss of weight. At the second operation, November

* Read before the American Surgical Association, May 2, 1922.

24, 1920, a crater-like mass was found at the lesser curvature of the stomach, necessitating a sleeve resection and end-to-end anastomosis. For some reason the appendix was not removed at this time. Five days later the patient developed acute appendicitis, and at operation an acute, perforating, gangrenous appendix was removed. After this, recovery was uneventful. This patient reported in person to our Follow-up Clinic in January, 1922, entirely relieved of the conditions for which the operations were done. He was able to return to work one month after leaving the hospital and had practically regained his health and strength.

Sometimes patients who do not benefit by operation report a recurrence of bleeding. Of course, in the presence of a new ulcer the cause for the hemorrhage is apparent. Occasionally, however, it may be due to focal infection from a diseased gall-bladder, or a diseased appendix not removed at the time of the ulcer operation, and sometimes also from a pancreatitis which develops after the original operation. Bleeding following operation for duodenal ulcer located upon the inner wall of the second portion of the duodenum where excision of the ulcer cannot be made is not to be unexpected. I have in mind a patient operated upon in December, 1911, where the induration of a duodenal ulcer extended to and involved the head of the pancreas. The outer wall of the duodenum was infolded over the ulcer and a posterior gastro-enterostomy done. The patient remained perfectly free from symptoms until about three months ago, when he was seized with a severe hemorrhage, vomiting bright red blood. The bleeding fortunately yielded to medical measures, but the ultimate outcome is still a matter of doubt.

In a few instances ulcer patients return for operation on account of intestinal obstruction. While this may be the result of adhesions, it is more likely to be caused by incarceration of a knuckle of gut between the margins of the anastomosis and the opening in the transverse mesocolon. This, of course, is largely a matter of surgical technic which can be avoided by suturing the anterior and posterior margins of the opening in the transverse mesocolon to the stomach.

Making the operation suit the case is, of course, an important item in the end-results. Excision of the ulcer wherever possible and a posterior gastro-enterostomy is still, in my opinion, the operation of choice. I was able to do this in forty-five per cent. of the patients among those who reported complete cures. Excision in some instances was done with the cautery, but in most it was done with the knife.

In certain cases where the stomach has not lost its motility and where there is no perigastritis, pyloroplasty may be indicated, but none of the cases in this series of fifty were so treated.

Radical operation for peptic ulcer, especially for ulcer of the stomach, is gaining favor. This was the choice of twelve per cent. of the series of cured cases. It consisted either of a sleeve resection, a pylorectomy, or a subtotal

PEPTIC ULCER

gastrorectomy. One of the latter had been done in 1910 and the patient is still in perfect health. In our experience the sleeve resections cause the least anxiety.

There is a tendency to minimize the value of posterior gastro-enterostomy as of itself capable of curing peptic ulcer in many cases. It certainly does procure complete relief of symptoms for a period of time. This is evidenced by the fact that of the cases in which the ulcer was not excised and in which only a posterior gastro-enterostomy was done, eighteen per cent. reported freedom from symptoms for one to five years after operation.

To return to the question of excision of the ulcer, excision, of course, removes the menace of hemorrhage, perforation, and finally of malignancy. No matter what the percentage of malignant degeneration, which in my experience is high, may be, it is a menace that must be reckoned with, particularly as we have no means of foretelling which will and which will not ultimately develop carcinoma.

In conclusion, I have no hesitancy in repeating what I have on so many occasions emphasized, that the end-results are also dependent on the concomitant treatment of other foci of infection, particularly the appendix and the gall-bladder. Appendectomy is now a routine procedure in my clinic in connection with surgery for peptic ulcer, while cholecystectomy is done when the gall-bladder is diseased. Twelve per cent. of the cured cases had this additional operation performed.

Does not the surgeon of experience well know that by the time many, if not practically all, ulcer patients when they reach the operating table have a history of having been cured medically many times? Is not this delay in failure to recognize, that only by mechanical measures can the ulcer be gotten rid of, responsible for a number of the cases of engrafted carcinoma? It has been said the chronic ulcer patient is the property of the internist after having recovered from the operation. I will not take exception to this; I do take issue, however, with my colleagues who advise a trial of medical treatment for the chronic ulcer patient. My experience has taught me this is not only useless, but encourages delay which is too often dangerous. A chronic ulcer is always a chronic ulcer until removed.

Removal of the gall-bladder and the appendix at the time of the ulcer operation should be done, and is attended by little, if any, additional risk, providing the patient is in other respects normal, as determined by the various tests which you are all familiar with.

THE CHOICE OF OPERATION FOR GASTRIC ULCER IN VIEW OF THE LATE RESULTS*

BY GEORGE WOOLSEY, M.D.

OF NEW YORK, N.Y.

IN a consecutive series of fifty-seven cases of gastric ulcer, on which I have operated, the results, together with the symptoms and the pathology, have been studied with special reference to the choice of operation in various types of cases.

Seventy-five per cent. of these have been operated in the past six years, several of two types of operation date further back. Cases of acute or chronic perforation are not included.

There are five types of operation in this series: (1) Gastro-enterostomy; (2) excision; (3) mesogastric resection; (4) resection by the Billroth II method; (5) resection by the Polya method.

I. Simple gastrojejunostomy was practiced in nineteen cases, nearly 60 per cent. of which were done before the six-year period, above referred to, and none in the last three years. It is the simplest and safest of the five types of operation, but what as to its results? In four there was no return record, and, of the remaining fifteen, ten (66.6 per cent.) were well, two (13.3 per cent.) were improved, and three (20 per cent.) unimproved, at an average return date of thirty-four months after operation. Combining the well and the improved, the results were good in 80 per cent., a fairly creditable record.

When we come to study the cases we find that the ulcer was at the pylorus, or near it, in sixteen cases and in one its site was not specified. In seven of these there was marked cicatricial stenosis of the pylorus, with marked dilatation of the stomach in five. Vomiting was a prominent symptom in sixteen, and the presence of pyloric obstruction is shown by the fact that in five of these cases the vomitus contained material long before ingested. Also visible exaggerated peristalsis was noted several times.

It is in such cases of pyloric stenosis that simple gastrojejunostomy gives excellent results, and the results were good when the ulcer was near the pylorus, without producing marked stenosis. But in two cases the ulcer was near the middle of the stomach, on the posterior surface. One has no return record but the other has remained perfectly well, doing hard work, for over eight and a half years. Thus a cure may be effected even in such unfavorable cases, by gastro-enterostomy alone. At the present time, however, we would undoubtedly resect such ulcers if the patient's condition justified it.

The type of the lesion is indicated by the fact that in eight cases there was vomiting of blood, while in two others there was blood in the stools in six cases the stomach was adherent to the under surface of the liver and in four

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cases to the pancreas. The duration of symptoms averaged eight and one-quarter years, the average loss of weight, in the ten cases where this is noted in the history, was thirty-four and three-tenths pounds. Four were heavy drinkers, one had been previously operated for a perforating ulcer, without gastro-enterostomy, and the ulcer had recurred.

As to the technic of the operation two, dating back eighteen to twenty years, were done by the anterior method with the Murphy button, both giving excellent end results. In the remaining seventeen cases posterior gastro-enterostomy was done in all but three where, on account of marked posterior adhesions, a short loop retro-colic anterior gastro-enterostomy was done. This modification I first employed in 1910 and I have also used it in resections for ulcer and carcinoma with excellent results.

In five of the fourteen cases of posterior gastro-enterostomy the pylorus was excluded by the Wilms method in four and by infolding in one. But these gave no better results than without exclusion and this modification was discontinued.

Of the three cases classed as unimproved one was well for eight months when symptoms recurred. Later the pyloric end of the stomach was resected and he is now, five and a half years after the first operation, well as to gastric trouble. Another, well for three years, relapsed after drinking heavily and was resected. The ulcer found at the second operation was in the same region of the stomach, but on the opposite side, *i.e.*, an entirely new ulcer had formed. The third of these cases was not seen, but after being well for three and three-quarters months after operation, wrote three months later that she was hopelessly sick. One of the good results I saw two weeks ago, perfectly well fourteen and a half years after the operation. There was no mortality in this group.

II. The excision group is as small as any and four of its eight cases were done before 1916. The first one was done ten and a half years ago without gastro-enterostomy, but required it four months later on account of the early return of symptoms, which again recurred, and two years later a *v. Eiselsberg* exclusion was done. At these recurrences a duodenal ulcer, not present, or observed, at the first operation, was probably responsible for the symptoms. After the exclusion he was well for five and a half years, until attacked by persistent jaundice. An exploratory operation, done in Colorado, revealed a carcinoma which was thought by the operator to have had its origin in the pancreas or the stomach. If the stomach was the starting point of the growth this is the only case in this series where gastric cancer has occurred after an operation for ulcer. It can hardly be called a cancerous degeneration of a gastric ulcer, for the ulcer was excised and the later symptoms were due to the duodenal ulcer.

Three of this group gave no return record and one of these had no gastro-enterostomy. Of the remaining five, two (40 per cent.) are well, two (40 per cent.) are improved, and one, the first case mentioned, was well for five and

a half years after relapse and reoperation. This gives 80 per cent. of good results.

In one case there were multiple ulcers, three shallow ones with a moderate hour-glass constriction of the stomach, and one in the duodenum. All but two of the ulcers of this group were on the lesser curvature. Vomiting was present in half of the cases and in all of these blood had at some time been present in the vomitus. In one case the hæmoglobin was 36 per cent., or less, at the time of operation.

The superiority of fluoroscopic examination was demonstrated in one case by visualizing a small penetrating ulcer of the posterior surface which was not shown by the X-ray plates.

The rather unsatisfactory results of the earlier cases have probably deterred me from favoring excision as much as I might otherwise have done. In the last six years it has been restricted to ulcers far removed from the pylorus and always combined with gastro-enterostomy. Such operations are usually quite as difficult as a resection, when that is applicable. As a resection has given me better results in ulcers nearer the pylorus I have limited excisions to ulcers not suitable for resection on account of their distance from the pylorus. There was no mortality among these eight cases.

III. The mesogastric or sleeve resections form a group of nine cases. This operation was applied to those cases of ulcer at a distance of three to five inches (average nearly four inches) from the pylorus, when the antrum, distal to the ulcer, was relatively normal. It saves this part of the stomach which would be sacrificed by other forms of resection. For ulcers so situated it competes with excision. Of course if the substernal angle is narrow or the ulcer is too far from the pylorus, mesogastric resection is too difficult to be chosen. But the ulcers in this group were different from those in the excision group. They were larger and more indurated as a rule and, though two-thirds were at or near the lesser curvature, there were more adhesions, especially posteriorly. Five were adherent to the pancreas and in three the latter formed the base of the ulcer. Adhesions to the liver were present in three cases and an hour-glass contraction in one case. The glands were markedly enlarged in seven cases.

Gastrojejunostomy was not done at the primary operation in any case, thereby shortening the time of operation. The post-operative course was remarkably smooth in these cases, but the ultimate results were not so satisfactory. Three cases gave no return record and, of the remaining six, one is well, another is well after a secondary gastro-enterostomy. A third who had lues and obliterating endarteritis of the arteries around the ulcer was well for two and a third years when, after excesses in whiskey, symptoms recurred, and the result is unsatisfactory, as it was also in another case at an earlier date, making two unsatisfactory results. In the latter case an X-ray suggested an ulcer, or new growth, of the lesser curvature close to the line of resection, but the interpretation of X-ray plates, taken after these opera-

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tions, is sometimes difficult. Reoperation was advised, but he refused, and was lost track of. Two other patients were much improved; 33.3 per cent. well and 33.3 per cent. improved is of course not satisfactory, but it should be remembered that these cases were among the worst types of gastric ulcer. All of them had vomiting, two-thirds vomiting of blood, the average loss of weight was twenty-five pounds (four cases), three were heavy drinkers, another was formerly, two had lues, one tuberculosis and one marked arteriosclerosis. Three had ulcerated through into the pancreas. In the literature several series of mesogastric resections are reported with more encouraging results. In spite of the poor late results in this group I still believe that mesogastric resection has a place in gastric surgery in a limited group of cases, but I should be inclined to do an excision and gastro-enterostomy in more of this type and restrict mesogastric resection. There was no mortality in this group.

IV. Resection by the Billroth II method was done in a small group of eight. Two of them had previously had a gastro-enterostomy with temporary relief and recurrence of symptoms. This type of operation is particularly applicable in such cases.

It is among the cases of this group that all of the deaths after operation for gastric ulcer occurred in my experience, except in cases of perforated ulcer. There were four deaths among these eight cases. Two were due to anæmia from previous severe hemorrhage. One lived twenty-five days, the other a week, and might perhaps have been saved if his brother had consented to give blood for a second transfusion, or another donor could have been secured. In both of these a gastro-enterostomy with a v. Eiselsberg exclusion was planned but could not be carried out on account of the induration of the distal or pyloric segment. A simple gastro-enterostomy would have been the better course, but this does not always control the hemorrhage. The two other cases died of pneumonia; one of them was alcoholic and most of his vital organs were diseased. I do not think that the type of resection had to do with the mortality in this group. It takes a little longer than the Polya method, which, as seen by the fluoroscope, gives a nearer approach to the normal stomach and better functional results. Of the four other cases two have no return record and two are well. The figures are too small to afford a basis for judging the results.

V. The Polya type of resection was done in thirteen cases, if we include one which proved to be a duodenal ulcer. Twelve were done by the Polya-Reichel technic, one by the Polya-Balfour. The very satisfactory convalescence and results in these cases was the factor which led me to compare the results in these five types of operation for gastric ulcer.

It is especially suitable for ulcers of the pylorus or antrum not too far removed from the former. Of the twelve gastric cases three were noted as at the pylorus, stenosing the latter, and seven in the pyloric portion. Nine were adherent posteriorly, to the pancreas in six and to the mesocolon in one. Vomiting was noted in ten and in eight it relieved the pain. Blood

was present in the vomitus in five. Loss of weight varied from ten to thirty pounds and averaged sixteen pounds. The age of the twelve gastric cases averaged forty-nine and a half years and ranged from twenty-five to seventy-five years, four of them being sixty-six or over.

In the Polya resections I have almost always first divided the stomach on the proximal side of the ulcer. The distal end is then turned to the right, which facilitates the division of any posterior adhesions. The reverse is done in mesogastric resections, on account of greater ease. The end result was a cure in ten (83.3 per cent.), improvement in two (16.6 per cent.) and there was no report in one. In other words, a good late result was obtained in 100 per cent. at an average time of thirty and a half months after operation. One of the two cases classed as improved was well for a year until he resumed alcohol, when he had slight stomach symptoms and lost seventeen of the thirty-seven pounds he had gained. For the next two years his condition was satisfactory until, after sustaining a fracture of the base of the skull, he had some return of slight gastric symptoms. If we class this case as unsatisfactory it leaves 91.6 per cent. of good results.

The Polya type of operation has the advantage of saving time by combining in one step the closure of the stomach and the gastro-enterostomy. If time is very important the Polya-Balfour technic has a slight advantage. The House Staff of the 2nd Surgical Division of Bellevue Hospital, where the majority of these operations were done, has often commented on the smoothness of the convalescence of the patients after Polya resections. Most of them I have seen fluoroscoped once or several times, from six months to some years after operation, and a striking feature is the normal character of the emptying of the stomach, moderately slowly and intermittently and not in the precipitate way of some cases after gastro-enterostomy. In fact, after a time, the distal end of the stomach, having contracted somewhat, looks and acts much like a large pylorus. The Polya type of operation has given me better results than any other operation for gastric ulcer. There has been no mortality in this group.

Jejunal or gastrojejunal ulcer has not developed in any of these cases of gastric ulcer which have return records.

Of course I am aware that the number of cases in these five groups is too small to give accurate percentage values, but not to indicate relative values, except perhaps as to excision with the cautery or knife, followed by gastro-enterostomy.

CONCLUSIONS

(1) For ulcers, three to four or more inches from the pylorus, the choice lies between excision and mesogastric resection. On account of the better results I prefer excision and gastro-enterostomy, except for ulcers with hour-glass contraction and large indurated ulcers, especially those on the posterior surface.

(2) For ulcers near the pylorus, or within three inches or so of it, I prefer

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the Polya method. It is easy, reasonably rapid and has given the best results of any method.

(3) In case the operation is done in two stages, or a gastro-enterostomy has previously been done, the Billroth II method is the rational procedure, but the two-stage procedure is rarely called for in cases of ulcer.

(4) For ulcers at, or close to, the pylorus, especially such as cause a stenosis, a posterior gastro-enterostomy is the simplest and safest operation, gives good results and may be the method of election for those not experienced in resection. It is quite possible for such an operation to benefit or cure ulcers remote from the pylorus.

(5) The possibility of cancerous degeneration of a gastric ulcer would in general lead to its resection or excision, but, as was long ago pointed out by Kocher and others, such degeneration is quite uncommon in cases treated by gastrojejunostomy. In view, however, of this danger, whether we class it at a high per cent. with some or a low per cent. with others, I firmly believe in the complete removal of gastric ulcers by resection or excision unless the operative risk is greatly increased on account of the general or local condition of the patient.

A BACTERIOLOGIC STUDY OF THE FLUID CONTENTS OF 100 GALL-BLADDERS REMOVED AT OPERATION

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THERE is an idea, just how prevalent is not known, that the fluid contents of diseased gall-bladders often, if not always, contain bacteria. In view of this idea it has been considered wise to review the subject and to make observations.

The fluid contents of 100 unselected gall-bladders removed at operation were cultured. In making these tests there was no thought of asserting that the isolated organisms were those causing the disease of the walls, but simply to ascertain whether bacteria were present in the contained fluids possibly rather as secondary invaders whose existence had been rendered possible by changes in the contents of the gall-bladders attendant on changes in the walls. The term gall-bladder fluid rather than bile has been used advisedly, since in many cases there is very little bile present, the contents consisting largely of mucus, serum, blood, and degenerated epithelial and pus cells. Schöbl, in his work on "Experimental Cholera Carriers," observed at necropsy of guinea-pigs and rabbits, into whose gall-bladders he had injected cholera vibrios, that there were marked changes in the walls of the organs, and, that the fluid contents were very much altered; in some cases it was light yellow, in others a thin colorless liquid with a creamy sediment. The latter condition was observed in cases in which the cystic duct was occluded by inflammatory reaction. In none of the cases of this series in which bacteria were isolated did the fluid resemble pure bile; it consisted rather of mucus or fluid of a serous nature and in two cases there was no visible evidence of bile being present. The fluid was obtained, aseptically, as follows:

After searing an area of the outer surface of the wall of the organ, a sterile capillary pipette was introduced. Test tubes containing one per cent. glucose bouillon were inoculated with the withdrawn fluid serobically and anaerobically and incubated at 37° C., and plates of Teague's eosin-brilliant green agar were streaked with the same. This latter medium was used with the hope of isolating *Bacillus typhosus*; as this medium is supposed to inhibit the growth of all gram-positive, and all gram-negative organisms except *Bacillus typhosus* and an occasional strain of *Bacillus coli*. This has been found to be the case with laboratory cultures, but, to freshly isolated strains of *Bacillus coli* and a few other gram-negative organisms, such as *Bacillus pyocyaneus*, the medium is not inhibitory. However, to the trained eye the different aspect of these colonies is distinguishable from *Bacillus typhosus* and the diagnosis may be confirmed serologically and by planting in Russell's sugar-agar medium.

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TABLE I

Infection in the Fluid of 100 Unselected Gall-bladders Removed at Operation

Patients		Average age, years	Infected fluids	Non-infected fluids
Men.....	30	46.1	6	24
Women.....	70	40.0	13	57
Married.....	65	40.8	13	52
Single.....	5	29.8		5
Total.....	100		19	81

TABLE II

Varieties of Bacteria Isolated from Nineteen Infected Fluids

Patients	Bacillus coli	Staphylococcus aureus	Streptococcus hemolyticus	Sarcina, non-pigmented*	Total
Men.....	3	1	1	1	6
Women....	9	3	1		13
Total..	12	4	2	1	19

* This organism will be regarded by some as a contaminator, but as sarcinae are sometimes present in the stomach¹ and intestine^{2,3} it is possible that a strain may have found its way into the fluid contents of a diseased gall-bladder.

TABLE III

Gross Pathologic Conditions in 100 Gall-bladders

	19 Infected fluids			81 Non-infected fluids		
	Per cent.			Per cent.		
	Men	Women	Total	Men	Women	Total
Acute and chronic catarrhal cholecystitis.		5.2	5.2	2.4	2.4	4.8
Subacute cholecystitis.....	5.2		5.2	1.2	2.4	3.6
Subacute and chronic catarrhal cholecystitis.....	5.2	15.7	20.9	3.7	4.9	8.6
Chronic catarrhal cholecystitis.....	26.3	68.3	94.6	23.4	60.5	83.9
Chronic cystic cholecystitis.....					2.4	2.0
Pericholecystitis.....	5.2	5.2	10.4		1.2	1.2
Papillomatous cholecystitis.....		5.2	5.2	3.7	2.4	6.1
Strawberry gall-bladder with chronic catarrhal cholecystitis.....	5.2	10.4	15.6	9.8	24.6	34.4
Cholelithiasis.....	31.5	42.1	73.6	7.4	38.2	45.6
Empyema.....		10.4	10.4		1.2	1.2
Strawberry gall-bladder with cholelithiasis.....				2.4	12.4	14.8
Strawberry gall-bladder with papillomas.		5.2	5.2	1.2	3.7	4.9
Stone in cystic duct.....		5.2	5.2			

TABLE IV

Findings in the Nineteen Infected Fluids

	Cases	Cholelithiasis, per cent.	Papillomatous cholecystitis, per cent.	Strawberry gall-bladder with chronic catarrhal cholecystitis, per cent.
Bacillus coli.....	12	75	8.3	16.6
Staphylococcus.....	4	75		25.0
Streptococcus.....	2	50		
Sarcina.....	1	100		
Total.....	19			

From the foregoing facts it seems that a very small percentage of the fluid contents of diseased gall-bladders contain organisms capable of being grown on ordinary mediums. This failure in growth might be explained by the inhibitory action of bile on bacteria and a series of tests using various dilutions of bile inoculated with different organisms was studied in the following manner:

Eighteen organisms were inoculated into 10, 70, 80, 90, and 100 per cent. of ox-gall, the dilutions being made with 1 per cent. glucose-bouillon. Controls in 1 per cent. glucose-bouillon were also made. The results are shown in Table V.

TABLE V
Effect of Bile as a Medium on the Growth of Organisms

Organism	Strains cultured	Glucose-bouillon, 1 per cent.	Ox-gall				
			10 per cent.	70 per cent.	80 per cent.	90 per cent.	100 per cent.
<i>Staphylococcus albus</i> ...	1	+	+	+	?	—	—
<i>Staphylococcus aureus</i> ...	3	+	+	+	?	?	—
<i>Streptococcus hemolyticus</i>	2	+	+	+	?	?	—
Non-pigmented sarcina.	1	+	+	—	—	—	—
<i>Sarcina lutea</i>	1	+	+	+	+	?	—
<i>Bacillus pyocyaneus</i> ...	2	+	+	+	+	+	—
Friedlander's bacillus...	2	+	+	+	?	?	—
<i>Bacillus coli communis</i> ...	17	+	+	+	?	—	—
<i>Bacillus coli communior</i> .	1	+	+	+	?	—	—
<i>Bacillus typhosus</i>	3	+	+	+	?	—	—
<i>Bacillus paratyphosus</i>							
A.....	1	+	+	+	+	—	—
<i>Bacillus paratyphosus</i>							
B.....	1	+	+	+	+	?	—
Flexner's bacillus.....	1	+	+	+	?	—	—
Shiga's bacillus.....	1	+	+	+	—	—	—
<i>Bacillus alkaligenes</i> ...	1	+	+	+	?	—	—
<i>Bacillus aerogenes</i>	1	+	+	+	+	—	—
<i>Bacillus enteriditis</i>	1	+	+	+	+	—	—
<i>Bacillus proteus vulgaris</i>	1	+	+	+	?	—	—
Total, per cent....		100	100	+94.2 — 5.8	+33.3 ? 55.5 — 11.1	+ 5.5 ? 27.7 — 66.6	100

These organisms, with the exception of the non-pigment-forming sarcina, all grew well in the control solution and in 10 and 70 per cent. ox-gall, while in 80 per cent. ox-gall only 33.3 per cent. of the organisms grew; in 90 per cent. ox-gall only 5.5 per cent. grew, and there was no growth in the pure ox-gall. This last fact caused no surprise as, a few years previously, it had been found impossible to keep three strains of cholera vibrio alive in pure bile, while there was no difficulty in doing so in a 50 per cent. dilution with plain bouillon. The results obtained from these tests, repeated many times, tend only to increase the belief in the hypothesis that organisms will not grow in pure bile, and that in order to produce a culture the medium must not contain more than 70 per cent. of bile.

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It may be contended that pure ox-gall is used for the isolation of *Bacillus coli* and *Bacillus typhosus* from blood, water, and milk, and exception may be taken to the foregoing results; but this objection is overruled by the fact that in none of these cases is pure bile really the medium as the amounts of blood, water, and milk inoculated are such as to dilute the bile sufficiently to allow of growth. It is a significant fact, the larger the amount of suspicious fluid introduced into this pure bile medium, the greater the chances of obtaining a positive culture, and it may be rightly contended that this is owing not so much to the greater likelihood of introduction of organisms, as to the fact that there is a higher dilution of the bile medium. For example, 10 c.c. of pure bile inoculated with 5 c.c. of blood, water, or milk will give a bile content of only 66 per cent. and 10 cm. with 1 c.c. one of 90.1 per cent.; it is a well-known fact that very often no growth of bacteria takes place after such a small amount of suspicious fluid is introduced. A comparative series of tests was made with fluids from ten gall-bladders removed from patients at operation; the fluid had been proved sterile by incubating and culturing. *Bacillus coli* was utilized as the inoculating organism and control cultures were made with a 1 per cent. solution of glucose-bouillon (Table VI).

TABLE VI
Effect on the Growth of *Bacillus Coli* of Gall-bladder Fluid from Ten Patients

	Concentration			
	70 per cent.	80 per cent.	90 per cent.	100 per cent.
Fluid 1.....	+	—	—	—
Fluid 2.....	+	—	—	—
Fluid 3.....	+	—	—	—
Fluid 4.....	—	—	—	—
Fluid 5.....	—	—	—	—
Fluid 6.....	—	—	—	—
Fluid 7.....	—	—	—	—
Fluid 8.....	—	—	—	—
Fluid 9.....	?	—	—	—
Fluid 10.....	+	+	+	+
Total results, per cent.....	+40 ? 10 —50	+10 —90	+10 —90	+10 —90

Control cultures with one per cent. glucose-bouillon were positive in every instance.

The tests with the first three fluids seem to show that increased concentration of fluid reduces the possibility of the successful growth of the organism. From this it may be inferred that fluids 4, 5, 6, 7, and 8 were probably of higher concentration than fluids 1 to 3; and that fluid 9 was of moderate concentration; the concentration of fluid 10 must have been low, as there was growth in all dilutions.

In order to rule out the possibility that these results were due to the presence or absence in these fluids of immune bodies for these bacteria, another series of tests was made. Fluids from four gall-bladders, removed at operation, were pooled and proved sterile. This fluid was not heated or treated in any way that might destroy any contained immune substances.

Dilutions were made and inoculated with *Staphylococcus aureus*, *Bacillus coli*, *Bacillus typhosus*, and *Bacillus pyocyaneus*; controls were made in 1 per cent. glucose-bouillon. In Table VII are recorded results which seem to corroborate the conception that immune bodies in the gall-bladder fluid, if present, do not inhibit growth in the experiments herewith reported.

TABLE VII
Effect of Possible Immune Bodies in Bile on the Growth of Organisms

	Pooled, sterile fluid from four gall-bladders				
	Glucose-bouillon, 1 per cent.	10 per cent.	50 per cent.	70 per cent.	100 per cent.
<i>Staphylococcus aureus</i> I.....	+	+	+	+	—
<i>Bacillus coli</i> V.....	+	+	+	+	—
<i>Bacillus typhosus</i> II.....	+	+	+	+	—
<i>Bacillus pyocyaneus</i> II.....	+	+	+	+	+
Total, per cent.	100	100	100	100	-75 +25

The growth of *Bacillus pyocyaneus* in a 100 per cent. concentration of this mixed fluid points to the fact that either this was in reality not of such high concentration or that *Bacillus pyocyaneus*, being a very resistant organism, can grow in mediums where other organisms cannot. It might be contended that this lack of growth in the greater concentrations was owing to the presence of immune bodies which are absent in the higher dilutions.

Table VIII shows similar results obtained when sterile ox-gall was substituted for the mixed human fluid from the gall-bladders of ten patients.

TABLE VIII
Effect of Substituting Sterile Ox-gall for Mixed Fluid of Foregoing Experiment

	Glucose-bouillon, 1 per cent.	Sterile ox-gall			
		10 per cent.	50 per cent.	70 per cent.	100 per cent.
<i>Staphylococcus aureus</i> I.....	+	+	+	+	—
<i>Bacillus coli</i> V.....	+	+	+	+	—
<i>Bacillus typhosus</i> II.....	+	+	+	+	—
<i>Bacillus pyocyaneus</i> II.....	+	+	+	+	?
Total, per cent.	100	100	100	100	-75 ? 25

From these experiments it seems to be quite permissible to assume that the growth of bacteria will not take place in pure bile and the reason that infected gall-bladder fluid is found in such a small percentage of cases (nineteen) is because the concentration of bile is too high to permit of the growth of bacteria. Rous and McMaster, in 1921, advanced the theory that concentration of bile is one of the functions of the gall-bladder.

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CONCLUSIONS

1. In a series of 100 gall-bladders removed at operation only 19 per cent. contained fluid infected with bacteria; the infecting organisms were *Bacillus coli* in 12 per cent. of the cases, a staphylococcus in 4 per cent., a streptococcus in 2 per cent., and a non-pigment-forming sarcina in 1 per cent.

2. The probable reason there is not a higher percentage of infected gall-bladder fluids is that the contained fluids have a concentration of bile too high, for bacteria will not grow satisfactorily if more than 70 per cent. of bile is present.

3. In the 19 per cent. of infected gall-bladder fluids the concentration of the normal bile had been lowered by inflammatory exudates, thus permitting the growth of bacteria in the fluid contents of the gall-bladders.

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TRAUMATIC PANCREATITIS

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THE pancreas is rarely injured. Even in penetrating gunshot wounds of the abdomen the percentage of pancreatic injuries is exceedingly low, much lower, in comparison to injuries to other organs, than the size of the pancreas would lead one to think.

Many pancreatic injuries are never recognized because death follows quickly and no autopsy is performed. Wallace reports (*Lancet*, 1917) only five injuries to the pancreas in 965 penetrating gunshot wounds of the abdomen, while Frazer and Drummond (*British Medical Journal*, March, 1917) found only one pancreatic injury in 300 gunshot injuries of the abdomen.

In the case where a cyst arises subsequent to the pancreatic injury, the following conditions probably obtain:

The pancreas is torn or mashed in such fashion that some of the ducts are divided, with escape of pancreatic juice. Hemorrhage, of lesser or greater degree, occurs at the same time. If the peritoneal coat over the pancreas is torn, as is usually the case, then there will be fat necrosis involving the omentum. An adhesive peritonitis follows, sealing in the injured spot or spots of the gland.

The pancreatic fluid continues to form, pushing its way between the peritoneal layers. Thus the cyst grows drop by drop, the endothelial lining of the wall contributing its share of fluid to dilute the pancreatic secretion. The color of the fluid varies as the amount of blood contained.

After a time when the intra-cyst tension has become very great, the torn ducts become sealed-off by contracting scar tissue, and at the same time the corresponding parenchyma cease to function and atrophy. The endothelium of the cyst wall may continue to secrete its fluid long afterward, the cyst thus growing larger and larger. Such a case came under my observation last year.

Case History.—D. L. S., a small negro boy, aged four, was admitted to the Hillman Hospital, April 26, 1921, with the history of having been injured two weeks prior. His parents averred that the rear wheel of a wagon had run over the child's abdomen. The child was somewhat shocked and complained of pain in the upper abdomen at the time of injury. At the time of admission there was a suggestion of fullness in the epigastrium, with slight tenderness over the same area. Temperature was normal, pulse normal, white blood-cells 13,000, urine normal, except for a trace of albumen.

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The parents were opposed to operation and took the child home after thirty-six hours in the hospital. He remained at home, being seen from time to time by a competent practitioner. About May 28th, or six and a half weeks after the injury, the patient was returned to the hospital by his physician. At this time there was a distinct globular swelling in the epigastrium about the size of an orange. It was tense, somewhat tender and almost completely fixed. Stereo-X-ray pictures showed a spherical cloudiness in the upper abdomen. Temperature normal, pulse normal, respiration normal, white blood-cells 10,000, urine negative. The history and findings, the shape and position of the tumor led us to make a diagnosis of pancreatic cyst.

Operation June 1, 1921; median incision above umbilicus. The omentum presented numerous yellowish-white spots of fat necrosis. A large globular cyst was immediately exposed, lying behind the stomach in the lesser sac. By tearing through the mesocolon the cyst was fully exposed, packed off and drained with trocar and canula, about three pints of limpid fluid escaping. The interior of the cyst was fully exposed and at the deepest part there was to be seen a small elliptical opening about the size of one's little finger-end. This opening communicated with the body of the pancreas at a point just to the left of the median line of the body. The edges of the cyst where the trocar had entered were sutured to the parietal peritoneum in the anterior abdominal wound, a large tube drain inserted deeply into the cyst cavity and the abdomen closed without other drainage. The laboratory reported that the fluid contained pancreatic ferments and that the omental tissue showed fat necrosis. Convalescence was uninterrupted. The secretion was never very profuse and gradually grew less. Daily irrigations of 1-10,000 silver nitrate were made into the cyst cavity. The secretion rapidly grew less and the patient gained in strength and weight. He left the hospital entirely healed, seventeen days after the operation. Since that time he has remained entirely well.

Stuart reported a case (*Northwest Medicine*, March, 1921) and collected fifty-three similar cases in the literature, in which the injury was subcutaneous. Of these the results were known in forty-six cases. There were thirty-nine operated upon, twelve died, twenty-seven recovered.

Ochsner reports a case (*ANNALS OF SURGERY*, October, 1921) of abscess of the pancreas successfully drained from behind. He first made an exploratory laparotomy.

The question of drainage of these cysts has been the subject of several papers in the recent literature, with a tendency to favor drainage from behind. Delatour, of Brooklyn, reports a case (*ANNALS OF SURGERY*, October, 1921) treated in this manner at the end of an exploratory laparotomy. The patient was cured.

I doubt if it is ever safe to approach such a swelling from behind, without

first exploring the contents of the abdomen under the naked eye. Posterior drainage, the force of gravity considered, appeals to one as most rational. In the case of pancreatic abscess, it should certainly be the operation of choice. Anterior marsupialization has given such satisfactory results in the great majority of cases reported in the literature that it should ordinarily be the operation of choice. Complete excision of the cyst may perhaps occasionally be accomplished with ease, but in the great majority of cases it will be found impractical and impossible.

FAULTY ROTATION OF THE INTESTINE*

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THE development of the intestinal tract in man and the lower animals has received a great deal of attention from anatomists and embryologists and the various stages of the processes involved are now well known and described. The intestinal tract of man in its development passes through phases which are permanent in some of the lower vertebrates, and a study of the splendid monograph of Huntington,¹ which is based on a very extensive investigation and knowledge of human and comparative anatomy, affords a mine of information concerning structural details and the ontogeny and phylogeny of the parts, as well as giving an explanation of many of the abnormalities which are observed in operations and at post-mortems.

It is not the purpose of the writer to attempt to describe the development of the alimentary canal, indeed it would obviously be quite unnecessary; some of the abnormalities will be alluded to, the clinical manifestations briefly discussed and a few personal experiences mentioned. These abnormalities are sufficiently common to merit consideration by the practical surgeon and numerous more or less systematic articles and many case reports are to be found in the literature.

Just why certain foetal conditions sometimes persist after birth is not certainly known; indeed, the cause of the rotation of the intestine around the superior mesenteric vessels is not positively determined. This rotation takes place to a varying degree in mammals, but not in lower vertebrates, and would seem to be in some way connected with the growth of the colon; probably several mechanical factors are concerned. Frazer and Robbins² suggest that rotation is due to the narrow aperture of the sac of the "embryonal umbilical hernia"; the cæcum, on account of its large size, returns later to the abdominal cavity than the small intestines and has to find room and adjust itself to the position of the small intestines which have previously returned. According to this view then, non-rotation might be accounted for by an earlier entrance of the cæcum into the abdominal cavity, due to its smaller size, or perhaps to a larger opening between the umbilical vesicle and the abdominal cavity.

When the colon fails to rotate the mesentery does not become fixed as a rule, and then it is possible for volvulus to occur, thus giving rise to intestinal obstruction. Intra-uterine peritonitis resulting in the formation of adhesions may account for failure of rotation as some have suggested.

The abnormalities to be mentioned will be considered under two heads:

* Read before the American Surgical Association, May 2, 1922.

1st, Faulty rotation. 2nd, Defective fixation of certain portions of the intestine. Both frequently are associated. No attempt is made here to mention all the anomalies that may be encountered.

a. Faulty rotation of the stomach, so that the pylorus is turned to the left; these may be associated with absence of fixation of the duodenum, which then has a free mesentery and volvulus may occur; such cases are quite rare.

b. Failure of the large intestine to rotate, resulting in the so-called "left-sided colon," the small intestine is on the right side of the large. In these cases the large and small intestine from the duodeno-jejunal junction to the end of the sigmoid may have a common mesentery, which is only two or three inches in width, and from this narrow mesentery nearly the entire intestinal tract is suspended. In instances of "mesenterium commune" the cæcum may be on the right side, as one of the cases to be referred to later will show, and there is a great likelihood of a volvulus to occur, the narrow neck of the mesentery becoming rotated. In other cases there has been fixation of the mesentery. In this group of course are to be placed the cases of left-sided appendix which are now and then found.

c. Failure of the cæcum to rotate, so that the ileum enters it from right to left, instead of from left to right, and some coils of small intestine are apt to be found behind the ascending colon. I have repeatedly encountered instances of this sort in searching for the appendix.

d. Failure of the cæcum to descend, so that it occupies a position just below the liver. The chief interest in this anomaly of course arises in cases of inflammation of the appendix, when the differential diagnosis becomes difficult or impossible, owing to the unusual position of the organ. When the colon fails to rotate, the superior mesenteric artery lies behind or dorsal to the duodenum, and the vasa intestini-tenuis come from the right side of the artery and the colic branches from the left; these abnormalities of the vessels have little or no surgical significance however.

e. Faulty fixation of the intestine: This is usually associated with defective rotation; there is absence of fixation of the large intestine or the fixation occurs in an abnormal situation. One of the more frequent forms of faulty fixation consists of the well-known mobile cæcum, which has a mesentery of varying length, and this predisposes it to various conditions which will be referred to later. Another common manifestation of faulty fixation consists in the attachment of the appendix posterior to the ascending colon and pointing upward.

Though not connected directly with rotation of the intestine, I should like briefly to refer to a developmental anomaly about the gall-bladder. This consists of the presence of the cystico-duodenal or cystico-colic fold, which extends from the gall-bladder to the duodenum or colon, in the shape of a double fold of peritoneum, and in its appearance is suggestive of a pathological adhesion. This ligament is really the right border of the gastro-hepatic omentum which extends further to the right than normal; it is fairly often seen.

FAULTY ROTATION OF THE INTESTINE

The presence of this fold may perhaps, by causing kinking of the neck of the gall-bladder and cystic duct, produce symptoms somewhat simulating gall-stones or cholecystitis. In a case in which gall-stones were suspected, because of moderately severe attacks of pain in the right hypochondrium, I found no stones or evidences of cholecystitis, but a very distinct cystico-duodenal ligament; this was divided and there have been for two years no attacks of pain. In two cases occurring recently, a diagnosis of duodenal ulcer was made by a röntgenologist from a deformed duodenal cap; at operation I found no ulcer, but there was in each instance a cystico-duodenal ligament, thus suggesting that this ligament may cause a deformity of the duodenal cap.

In these cases of faulty rotation of the intestinal tract, volvulus of a large part of the gut may occur, particularly in the instances of mesenterium commune, where the greater part of the colon and the whole of the small intestine except the duodenum are suspended by a narrow mesentery; also when the cæcum and the lower part of the ileum have a common mesentery. It is also likely that in such cases less severe and more temporary manifestations, in the shape of recurring attacks of cramp-like pains, sometimes associated with vomiting, can and do occur; in two of my cases there was a distinct history of repeated colicky attacks, extending over a period of years. Probably some instances of attacks of abdominal pain and of vomiting, which the clinician cannot account for, and which pass off spontaneously, can be explained by the developmental errors mentioned.

The possibilities of disturbance in the cases of mobile cæcum are numerous and there is not as yet agreement as to all of the clinical manifestations of this condition. The operation of cæcopexy to remedy this condition for a time was in vogue, but seems to be less frequently done of late. Appendicitis may be simulated by volvulus of the cæcum.

Irregularities and variations in mesenteric adhesion are also responsible in part at least for the formation of various fossæ, such as the duodeno-jejunal and intersigmoid, and these, as is well known, are occasionally the seat of internal or retroperitoneal herniæ.

In the diagnosis of some of these cases of errors of rotation, assistance has been obtained by X-ray examination.

The following cases will illustrate the leading features of volvulus of the whole or part of the intestinal tract, when due to errors of rotation or fixation.

CASE I.—Volvulus, of nearly the entire intestine, in a case of mesenterium commune: Male, age twenty-three years, operated upon for acute appendicitis. At the operation the cæcum was found in the right iliac fossa and nothing in particular was noted in regard to it except that it was freely movable; an acutely inflamed appendix was removed. On the fifth day after operation the patient had a great deal of nausea, vomiting and abdominal pain; some relief was afforded by gastric lavage. The vomiting, however, continued on the following days; the

epigastrium was distended, there was a succussion splash in the stomach, the lower abdomen was scaphoid, no bowel movements could be obtained and there was no fever. The condition was diagnosed as dilatation of the stomach and large quantities of fluid were evacuated by the stomach tube from time to time. He became progressively worse and died on the ninth day. We were told that the patient had had a number of attacks of abdominal pain and vomiting, dating back to childhood. The autopsy revealed the following facts: The stomach and duodenum were greatly distended; from the duodeno-jejunal junction downward the whole small and large intestine were practically empty, the small intestine being behind the large. Rotation of a narrow and long common mesentery had taken place from right to left, around the superior mesenteric artery for a distance of about 180° . The small intestine was much congested and the mesenteric veins were engorged. The cæcum which at the time of the operation had been on the right side, was now on the left.

In the above case, therefore, we have an instance of a persistent common mesentery of the large and small intestine, the cæcum had reached the right iliac fossa but had not become fixed; after the operation there occurred a volvulus from right to left around the narrow mesentery resulting in obstruction at the lower end of the duodenum. The epigastric distention and vomiting, and the absence of distention of the lower abdomen, which were observed during life were thus accounted for.

Volvulus of a loop of the ascending colon, the cæcum being fixed in the right iliac fossa, has been observed by Treves and Curschmann; this is exceedingly rare.

The appendix and apex of the cæcum may point toward the liver, the ascending colon being sharply bent, and instances of fatal obstruction from this cause are recorded. A loop of the transverse colon may lie between the liver and the anterior abdominal wall, thus giving rise to a resonant note on percussion at the usual site of hepatic dullness, and resulting in various difficulties in diagnosis.

When the cæcum and lower ileum have a common mesentery, and the cæcum has failed to become fixed, volvulus of these parts may occur. Two instances have fallen under my observation.

CASE II.—A young male, adult, suddenly seized with severe pain in the right lower abdomen; when seen twenty-four hours later, there were tenderness and distention in the right iliac region; normal temperature and a leucocytosis of 17,000. A diagnosis of appendicitis was made. At the operation the much distended cæcum was found to have a long mesentery, upon which it was rotated for about 90° ; when untwisted some gas passed on into the ascending colon and the rest was evacuated by removing the normal appendix. Recovery took place.

CASE III.—A young male, adult, who presented all the signs of an acute mechanical obstruction of the bowels; of three days' duration.

FAULTY ROTATION OF THE INTESTINE

At the operation there was found an enormously distended and almost gangrenous cæcum which was twisted on its long mesentery; it could not be delivered from the abdominal cavity; it was opened and a tube put in. The patient died on the sixth day of his illness. Inquiries made after the condition was recognized brought out the fact that the patient had had repeated attacks of abdominal pain of varying severity and duration. At the autopsy the cæcum was found to have a long mesentery upon which the gut had become rotated, resulting in obstruction and strangulation.

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PROLAPSE OF THE RECTUM IN CHILDREN*

THE D'ESPINE METHOD OF TREATMENT

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SURGEONS who have been connected with a children's hospital or dispensary know the difficulties encountered in dealing with prolapse of the rectum in children. A recent report by Findlay, of Glasgow (*Brit. Journ. Children's Dis.*, 1921, vol. xviii, p. 83), of the successful treatment of this disorder by injections with alcohol and the simplicity and ease of the method as well as the splendid results, stimulated me to give the method a trial, with results so satisfactory that I feel justified in making this contribution to the subject.

Findlay first observed the procedure in D'Espine's Clinic at Geneva in 1919. He subsequently treated twenty-two cases, the children ranging from five months to five and one-half years of age, in some of them the prolapse having been present for a number of years. A complete cure was obtained in every instance.

Submucous injection for the relief of prolapse of the rectum is not a new procedure. Langenbeck several years ago recommended injections of ergot, alcohol and glycerine, while other surgeons have advised strychnine, ergot and strychnine, white oak bark, carbolic acid, etc. The use of the last two, especially carbolic acid, has been entirely discarded on account of the danger of infection.

The submucous injection method as a treatment for prolapse of the rectum does not seem to have met with favor, since very little mention is made of it in text-books, probably on account of the danger of infection or its failure to produce a cure. Neither of these objections seem to apply to D'Espine's alcohol injections. Findlay makes no mention of infection or other untoward effects in any cases so treated.

It is true that prolapse of the rectum in children can often be cured by carefully studying the patient, regulating the diet, removing the irritating causes if any exist, controlling the diarrhoea, or in some instances constipation, strapping the buttocks, and the administration of cod-liver oil or some other tonics. Some cases, however, do not yield to these conservative measures and demand more radical methods, such as cauterization or operation. While cauterization is very successful in prolapse of the anus and in partial prolapse of the rectum, the results in complete prolapse of the rectum are sometimes disappointing. The cure of complete prolapse of the rectum in children, and especially in adults, is, to say the least, difficult. Many opera-

* Read before the Philadelphia Academy of Surgery, May 8, 1922.

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tions have been devised with more or less, generally less, successful results. Some of them chiefly applicable to the condition as occurring in adults are as follows:

Hey, in 1788, with the idea of narrowing the anal canal, removed a small triangular piece of the orifice and sutured the gap.

Thiersch passed a silver wire subcutaneously around the anus.

Gurnsey sought to form a cylindric canal at the anal orifice by injecting wax at the rectal outlet.

Lange proposed infolding the wall of the ampulla, and Mummery packed the ischiorectal fossa with gauze. Other surgeons have resorted to hitching operations, such as rectopexy (Verneuil), colopexy (Jeannel), sigmoidopexy (Allingham).

Resection also has been advocated and tried. Mikulicz, for example, resected the prolapsed bowel; von Eiselsberg resected the sigmoid flexure and anastomosed it with the drawn-up rectum. All these operative procedures are formidable ones and scarcely to be supported by a young child already weakened by a more or less protracted enervating illness. Recurrence after most of these operations is not uncommon and the mortality in some is naturally high.

As to the cause of prolapse of the rectum. The most frequent exciting cause seems to be concerned with abnormal intra-abdominal pressure, with muscular weakness as the predisposing factor. Anatomically the rectum owes its support to the curve of the sacrum, the antero-posterior and lateral curves of the rectum itself, the meso-rectum, the peritoneum, levator ani and the sphincter muscles. The shape of the rectum, its valves, the ampulla and the peri-rectal fat and fascia, each in turn also plays its part. The fact that children are so much more frequently affected than adults seems to be due to the lax meso-rectum, the shallowness of the sacrum, as well as to the shape of the rectum and to weak muscular structure.

Some of the cases in the series of personal observations included in this report were studied for nerve changes, and by the X-ray for spina bifida, and abnormalities of the rectum and colon. The results were negative, except that all cases presented a weak and flabby musculature, the condition being generalized, but more marked in the muscles of the lower extremities.

Certain authorities believe that prolapse of the rectum usually begins with prolapse of the anus, but this hypothesis is not accepted by all. Others hold that prolapse of the anus is one of three types of prolapse in the rectal region, the other two being partial and complete prolapse of the rectum.

Partial prolapse is probably the most common form. Waldeyer has demonstrated that prolapse of the rectum usually begins, not by dragging from below, but from downward visceral pressure in the peritoneal cul-de-sac, while the exciting cause of anal prolapse may be polypus or hemorrhoids.

The technic of D'Espine's method, as described by Findlay, is as follows: The operation is performed under general anæsthesia, the patient having been

prepared in the usual way by purgation or by enema for completely clearing out the bowel. The perineum is cleaned with methylated ether and disinfected with iodine. The finger is placed in the rectum so as to gauge the position of the needle, and 1.5 c.c. of absolute alcohol is injected on each side of the rectum at about a depth of 7 cm. The needle (an ordinary exploratory needle with the syringe containing the required amount of alcohol attached) is inserted about 8 mm. (one-quarter inch) from the anal margin and is passed along the side of the bowel just outside of the mucous coat for about 6 to 8 cm. (two and a half to three inches) where the alcohol is injected. This is done, as already said, on both sides. The punctures are then sealed with collodion, and after applying a fairly large pad, the

TABLE I

Name	Sex	Age	Duration of prolapse	Cause of prolapse	Date of injection	Amount injected	Result
M. C....	M.	5 years	8 weeks	Ileo-colitis	8/23/21	2 lat. inj. 1.5 cc.	Cured
A. H....	F.	2 years	3 weeks	Diarrhoea	10/26/21	2 lat. inj. 1.5 cc.	Cured
A. B....	F.	33 mos.	3 weeks	Pertussis	10/26/21	2 lat. inj. 1.5 cc.	Cured
A. McK.	F.	5 years	1 year	Colitis	10/26/21	2 lat. inj. 1.5 cc. 2 injections, 4 points injected. Reoperation 6 weeks later. 1.5 cc.	Cured
C. K....	M.	2½ years	Unknown	Unknown	12/3/21	2 lat. inj. 1.5 cc.	Cured
J. K....	M.	5 years	Unknown	Unknown	12/3/21	2 lat. inj. 1.5 cc.	Cured
J. K....	M.	22 mos.	2 weeks	Diarrhoea	12/3/21	4 points injected, 1.5 cc.	Cured
G. B....	M.	4 years	3 years	Ileo-colitis	12/3/21	3 points injected, 1.5 cc.	Cured
A. R....	F.	13 mos.	12 mos.	Colitis	12/7/21	4 points injected, 1.5 cc.	Cured
E. H....	M.	4 years	1 year	Diarrhoea	1/12/22	2 points injected, 1.5 cc.	Cured
F. R....	F.	3 years	3 mos.	Diarrhoea	1/16/22	2 points injected, 1.5 cc.	Cured

buttocks are strapped. The child must be kept in bed for eight to ten days and the bowels kept constipated. The patient must not be allowed to sit up to defecate; the bowel movements are passed along the side of the dressing with the child lying in bed. The dressings are renewed daily, or as often as necessary, for eight to ten days, when they usually can with safety be discarded and the child then allowed to get out of bed.

I have used this method in eleven consecutive cases, two of them very severe ones, and have obtained a cure in each instance, without any post-operative complications, such as infection, loss of sphincter control, etc.

As will be seen in the accompanying table only one case required reoperation; this was done six weeks after the first injection, and in this case four punctures were made instead of two. The failure of the first injections in this patient was due, I believe, to the administration of a cathartic by mistake on the third day following operation.

I have thought it of interest to give the following case history in order to

PROLAPSE OF THE RECTUM IN CHILDREN

illustrate the severe type of prolapse that can be relieved by this simple method. It was this case that convinced me of the value of this procedure.

A. R., female, aged thirteen months, weight eleven pounds, three ounces, was brought to the Children's Hospital of the Mary J. Drexel Home of Philadelphia, October 3, 1921, for relief of prolapse of the rectum, which had been noticed when the child was three weeks old and had been gradually increasing until admission. The prolapse was down from 8 to 10 cm., and was ulcerated and oedematous. Accompanying symptoms were tenesmus, frequent watery mucous stools and general weakness. The child was bottle-fed since the third week of life.

Examination shows: Athreptic girl baby, thirteen months old, head square and chest moderately rachitic. Abdomen—liver palpable about 4 cm. below costal margin. Rectal—rectum prolapsed about 10 cm., the mucous membrane being inflamed and ulcerated at five or six points. Physical examination otherwise negative. The rectum could not be replaced without an anæsthetic on account of straining. When replaced under anæsthesia the prolapse immediately recurred. After many unsuccessful attempts to keep the rectum in place by means of strapping the buttocks, the prolapse was finally allowed to remain down and kept clean with boric acid ointment and every effort was then directed toward improving the child's general condition, which was so poor that operation could not be attempted.

On December 7th, two months after admission, the baby having gained two pounds, two ounces, in weight and the general condition having greatly improved, I decided to attempt reduction and fixation of the rectum by means of absolute alcohol, according to D'Espine's technic. The baby was first purged and then constipated by means of boiled milk, paregoric and bismuth subcarbonate.

The second day after operation the baby had three small constipated bowel movements but the rectum did not come down, nor was there any prolapse after that, in spite of the administration, at various times, of castor oil, calomel and cascara. X-ray studies of the intestinal tract and spine revealed no abnormalities.

From January 10 to 21, 1922, the infant weathered a severe attack of bronchopneumonia. It was finally discharged January 31, 1922, weighing sixteen pounds, eight ounces, without any sign of prolapse of the rectum; general condition good.

Findlay believes there are two factors responsible for the cure by this method of treatment. He believes that at the seat of injection there results a certain amount of irritation with the formation of fibrous tissue and a probable fixing of the bowel wall to the tissues of the pelvic cavity. He examined per rectum many of the cases at varying periods after the injections, but could detect no evidence of thickening, induration or stenosis of the bowel.

We have made similar examinations in the cases of this series without finding any stenosis, thickening or induration.

The other factor which Findlay calls attention to as playing a part in the cure is the early return of the tone of the sphincter muscle; in his experience the sphincter had quite regained its tone within ten days following the alcohol injection.

TREATMENT OF CANCER OF THE RECTUM*

By ROBERT C. COFFEY, M.D.

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THERE are but three agencies recognized in the treatment of cancer. These are cautery, radiotherapy and surgery. For obvious reasons, the cautery may be eliminated in the treatment of cancer of the rectum, except in the lower two inches, and even there it has no advantages. This leaves but two agencies with recognized standing for the treatment of cancer of the rectum. These are radiotherapy and surgery. Owing to its anatomical location, the application of X-ray is impractical, which reduces radiotherapy to the use of radium.



FIG. 1.—The sigmoid is mobilized by cutting the peritoneum on each side of its mesentery. Dotted line indicates incision of peritoneum of cul-de-sac around rectum and between bladder and rectum.

The remarkable success of radium in treatment of cancer of the uterus has led us to hope that the same might be true of cancer of the rectum. We have been greatly disappointed. A satisfactory reason for our failure to get good results in cancer of the rectum has not been given.

Hochenegg's clinic reports

more than seven hundred cancers of the rectum treated. Of these twenty-eight were treated by radium and only one gave good results. Many were made very uncomfortable and were worse than if no treatment had been given. Some other clinics have had equally disappointing results.

During the past three years I have used radium in eight cases of cancer of the rectum. In order to give the radium the greatest opportunity for cure, a preliminary colostomy was performed and the radium was drawn immediately into the growth as accurately as it could be done in carcinoma of the

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cervix. In some of the cases a rectal tube was passed down through the colostomy opening and out through the rectum. Radium tubes were arranged in tandem in the rubber tube. An annular pack of gauze was sewed around



FIG. 2.—Superior hemorrhoidal artery is ligated and cut. Also vessels of the mesosigmoid.

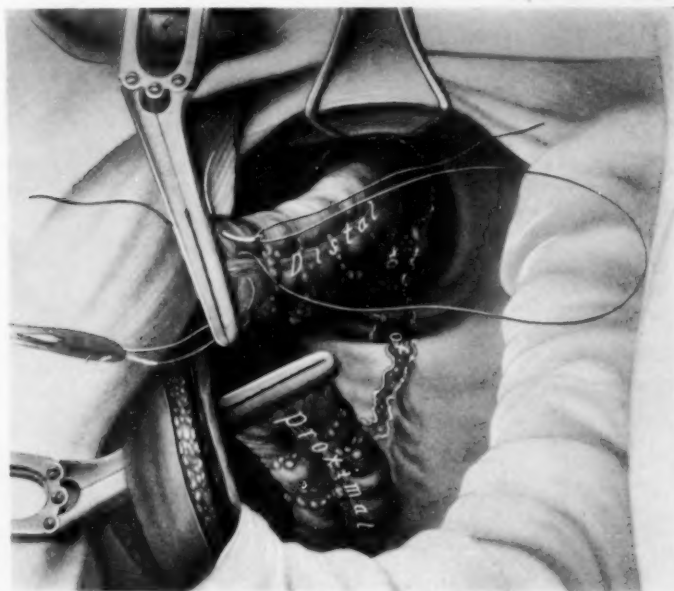


FIG. 3.—Clamping and cutting sigmoid after vessels have been ligated. Note one of the clamps passes through the stab wound of left rectus muscle.

the tube just partially covering the lower tube of radium. This circular pack of gauze was for the purpose of stopping the tube in the growth as it was drawn upwards. Gauze was then packed in the rectum below this and a safety pin passed through the end of the tube as it emerged from the colostomy opening. In cases where the growth was strictly limited to one wall of the rectum, a sheet of lead was placed on the opposite wall for its protection. In one case of very extensive cancer of the lower rectum, the growth apparently was temporarily killed. An annular scar took its place. Owing to the advanced condition of the disease, the patient died within a few months with extension farther up in the pelvis. No other patient was even temporarily cured

nor made more comfortable. Several of the patients suffered unspeakable pain, apparently the result of the radium. This pain was either in the back or in the bladder, or both.

While conceding that these were far advanced cases or that the growth was in most instances located at a difficult place for removal, the progress of these cases led me to believe that we could never expect results in cancer of the rectum from radium treatment in any way comparable with results obtained by radium treatment of cancer of the uterus. In fact, I shall not use radium in cancer of the rectum again except for some very extraordinary reason. This statement is made in face of the fact that I am very enthusiastic in the advocacy of radium for cancer of the cervix—even to the point of almost excluding radical surgery in treatment of carcinoma of the uterus, except in the earlier cases or in combination with radium.

Therefore we narrow the treatment of cancer of the rectum to the field of surgery. Surgery in treatment of cancer of the rectum may be palliative or radical. Palliative is naturally limited to those cases in which radical

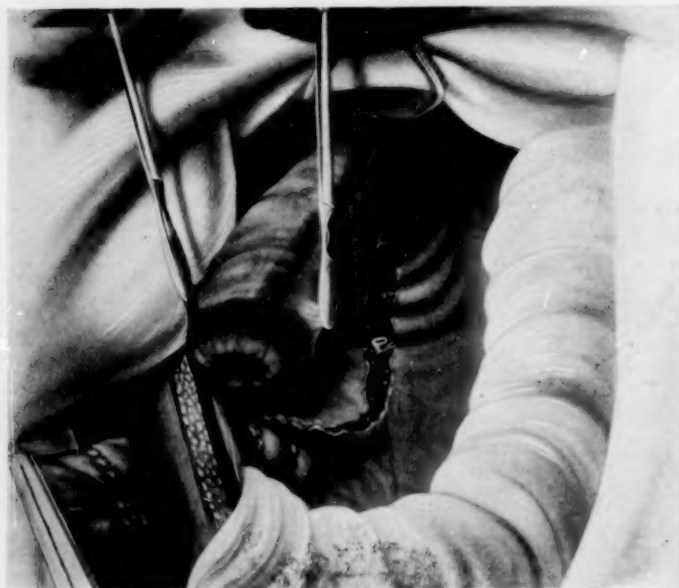


FIG. 4.—Proximal sigmoid held in clamp. Tube is passed up to end of distal sigmoid, where it is fastened by a strong double suture passed through the intestine and eyes of tube and tied. By pulling on the tube, the sigmoid is inverted and drawn out through the anus.

TREATMENT OF CANCER OF THE RECTUM

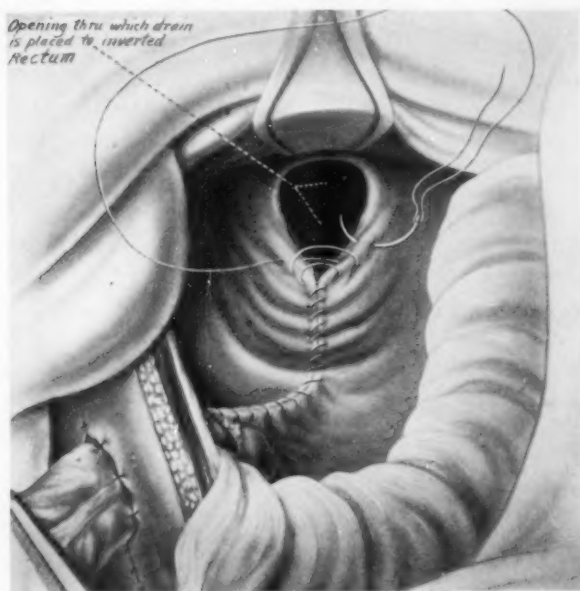


FIG. 5.—After the space between the sigmoid and the left lateral parietal peritoneum has been closed by suture, a continuous catgut is run along the mesosigmoid covering the raw fat edges with peritoneum down to the narrow portion of the cul-de-sac, where drain is inserted.

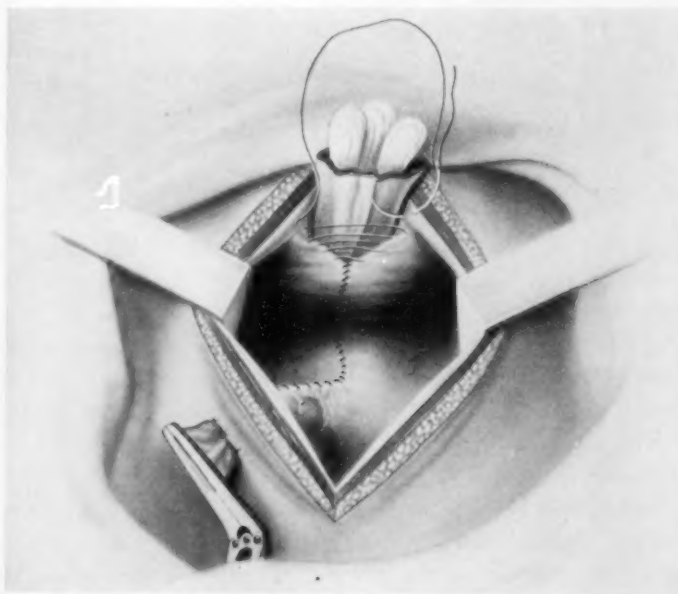


FIG. 6.—The suture line continues to bring the parietal peritoneum from the sides of the narrow pelvis around the drain until the abdominal incision is reached, making the drain extra-peritoneal.

removal is impossible, either because of too extensive local involvement of other organs or metastasis. The only hope for cure of cancer of the rectum is radical surgery.

In the past, surgery which offered reasonable hope for eradication of the disease has been so formidable as to appear almost prohibitive. The early work in the days of Kraske was accompanied by mortality of 50 or 60 per cent. Finally, development in the hands of such masters as Mayo, radical operation at one stage was reduced to about 25 per cent. One of the most dramatic fêtes of surgery fifteen or twenty years ago was the simultaneous operation in case of cancer of the rectum by Drs. W. J. and C. H. Mayo, one

operating above and the other below. Even with this combination of skill, the mortality was formidable and the end results anything but encouraging.

Then the two-stage operation came which cut the mortality almost in two, bringing it down to twelve or eighteen per cent. in the hands of the best operators.

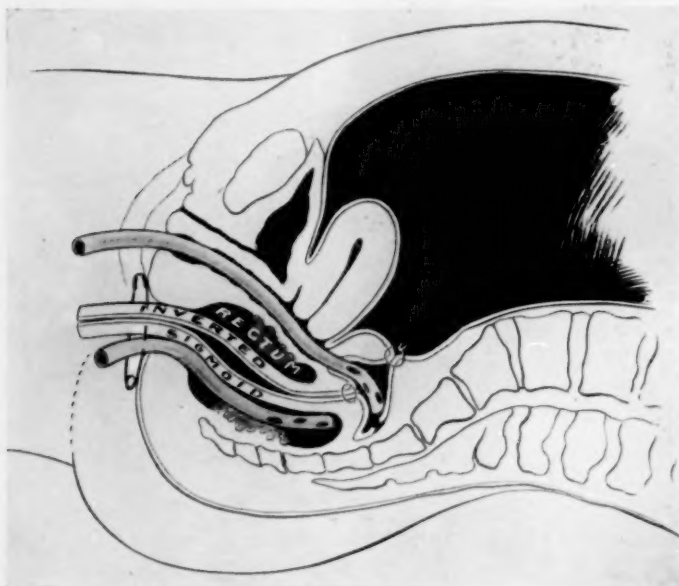


FIG. 7.—Diagram showing the supplementary drain passed through stab-wound in cul-de-sac in case of woman.

The two-stage operation performed was usually one of doing the colostomy first and doing the Kraske operation later. In other words, the major procedure was left for the last operation.

In the *ANNALS OF SURGERY*, April, 1915, I described a method of operating for cancer of the rectum in which the major procedure was done first and all the work finished in the abdomen. At this time a permanent colostomy was made. The superior hemorrhoidal artery, which is the chief blood supply of the inaccessible portion of the rectum, was doubly ligated and cut. A rectal tube which had been passed into the rectum was used to invert the distal end of the sigmoid and draw it out through the anus. This appeared to me to give less shock at the second operation than when the minor operation was done first and the major operation done later. The two principal points claimed for the operation at that time were the cutting off of the

TREATMENT OF CANCER OF THE RECTUM

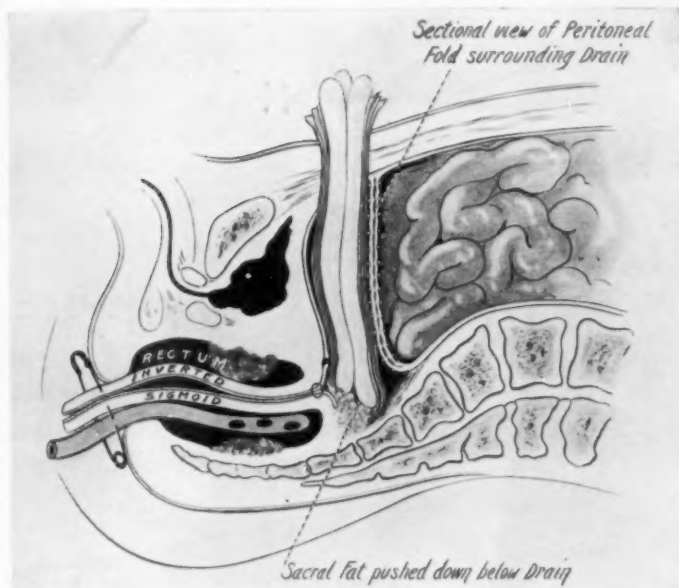


FIG. 8.—Sectional view of drains have been tubularized by the peritoneum of the pelvic wall. Fat in hollow of sacrum is pushed down, a drainage tube in rectum and inverted sigmoid held down by a safety pin.



FIG. 9.—Second stage of removal operation in woman. After incision around anus, back to coccyx, fingers are passed between rectum and vaginal wall to upper end of inverted rectum.

circulation and thus relieving one of the great dangers of the Kraske operation, second, closing the peritoneal cavity, relieving the danger of sepsis and peritonitis. We soon found that a complication arose in many of the cases. Not only the inverted sigmoid which had been devascularized by the ligation of the superior hemorrhoidal, but also the tissue in the hollow of the sacrum sloughed. This produced in the allotted ten or twelve days, which was given for the patient to recuperate from the first operation, a marked rise of temperature, lasting a week or ten days and finally an abscess would break into the rectum. This did not seem to be particularly serious, but was very undesirable and probably in a large series of cases would have produced considerable mortality. Therefore, we had to provide for drainage.

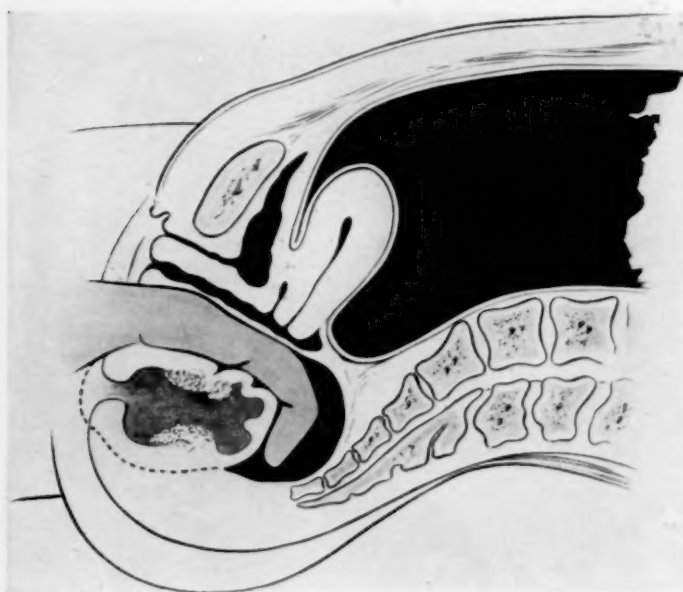


FIG. 10.—With the fingers flexed on the palm, the rectum and all the fat in the hollow of the sacrum scooped out intact.

not desirable and destroyed our idealism of completely finishing our work in the peritoneal cavity, but it worked quite successfully. Soon, however, we discovered that there was sufficient loose peritoneum on the wall of the narrow pelvis of man to enable us to continue our suture line used for closing the raw mesenteric borders, drawing in the loose peritoneum from the side of pelvis around our drain, making a peritoneal tube, which restored our idealism and enabled us to completely finish the operation.

The next question was that the operation, which required inversion of the bowel from above, was only applicable to those cases in which no great amount of obstruction had taken place. The operation of doing the major procedure first could not be used in that very formidable type of cases in

In the female this was easy by making a stab wound through the upper end of the vagina into the cul-de-sac. The problem was quickly solved in woman, but was not so successfully solved at first in man, for it required the placing of a drain down to the end of the rectum and bringing the drain up through the peritoneal cavity. This was

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which the growth involved the lower pouch of peritoneum and in which stricture is the earliest manifestation. Recently we have been able to overcome this difficulty and have applied the principles of using the major procedure first in these cases in a most admirable manner by removing the growth and all the contents of the hollow of the sacrum at the first operation from the abdominal side. So we now feel that we are able to deal successfully with cancer located anywhere in the rectum, including the rectosigmoid section, which is the most formidable location of a cancer in the gastrointestinal tract, except the cardiac end of the stomach.

The operation therefore may be divided into two types: First, operation for dealing with cancer of the lower rectum, in which it is possible to pass a rectal tube beyond the growth. Second, in which the growth is located high and in which stricture and obstruction are the first serious symptoms.

Operative Measures for the Relief of Cancer of the Lower Rectum.—The first stage of the operation is performed as follows:

(a) A rectal tube is passed into the rectum

through the growth before the beginning of the operation. This drains any contents that may be in the bowel.

(b) An ample incision is made through the right rectus muscle about an inch to the right of the median line. Through this incision the hand is passed, the liver and all other abdominal organs, including the rectum, are examined. By this means it is determined whether or not it is possible to completely eradicate the growth. If the growth is found removable, the patient is placed in Trendelenburg's position, all the intestines are packed back with moist gauze except the sigmoid, which is left entirely exposed.

(c) The peritoneum on either side of the mesosigmoid is cut, leaving only the blood-vessels and fat in the mesentery. The cut in this peritoneum

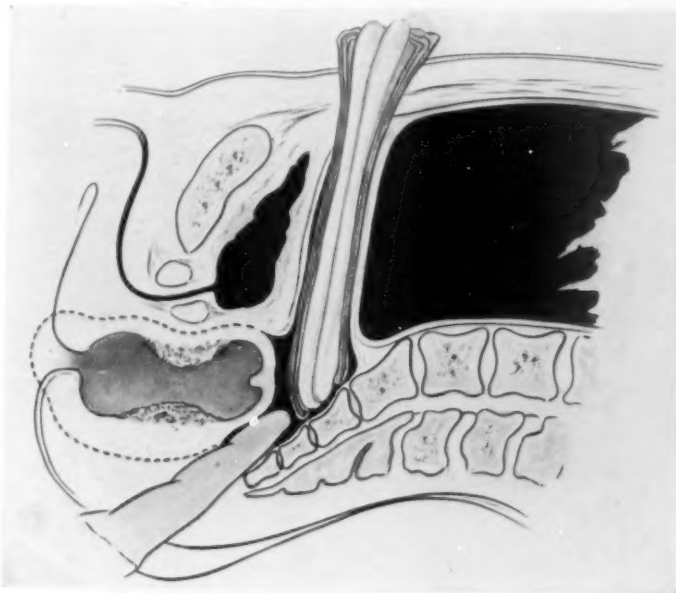


FIG. 11.—Second stage on removal operation in man. Patient is placed on face. Incision around rectum and backwards, coccyx removed, fingers of hand insinuated between rectum and sacrum until drain is touched.

is extended around the rectum between the bladder and rectum in man and between the uterus and rectum in woman. (Fig. 1.)

(d) By passing one finger between the vessels of the mesentery, the superior hemorrhoidal artery is felt pulsating between the thumb and finger. It is a large vessel and easily felt. A large artery forceps is used to grasp the artery in the mesentery above and another below the fingers and thumb. This squeezes out the tissues, leaving nothing but the artery. Two ligatures are then placed at these points and the artery is severed. (Fig. 2.) This destroys all the arterial supply to the lower sigmoid and upper rectum.

(e) In order to prevent soiling the field with venous blood, clamps or ligatures are placed on the vessels near the sigmoid, after which the vessels

are cut, the fingers of the left hand passed down the hollow of the sacrum, pushing the fat ahead and separating the fat and connective tissue from the hollow of the sacrum. There is practically no bleeding during this part of the operation, but a gauze pack is placed in hollow of the sacrum while the next step in operation is performed.

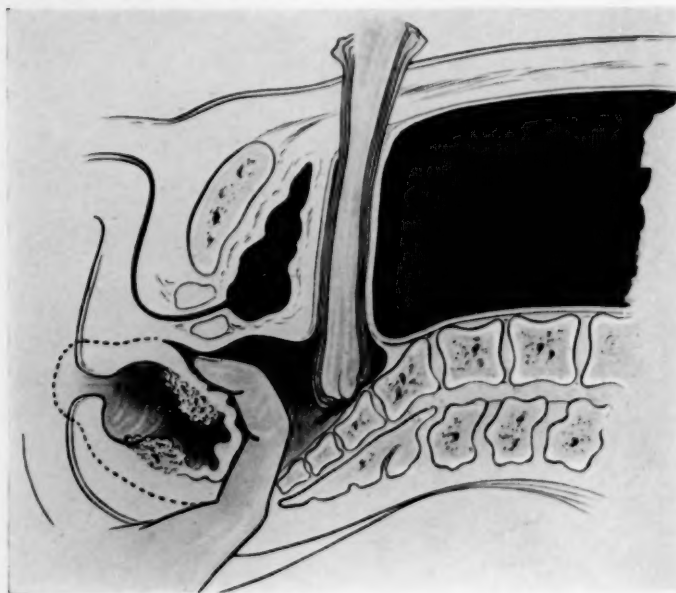


FIG. 12.—Fingers flexed on palm, separating rectum from bladder, prostate and urethra.

(f) This consists in severing the sigmoid and making the permanent colostomy. At this stage an incision, about an inch and one-half in length and about the same distance below the level of the umbilicus, is made longitudinally through the rectus muscle about its middle, separating its fibres. Peritoneum is picked up on either side, held in forceps for convenience later, and is opened. A Payr's crushing clamp is passed through the opening in the wall on the left side and grasps the sigmoid at the point of bowel desired for making permanent colostomy, careful observation being made as to the blood supply. Another similar clamp is placed below this one through the main abdominal incision. The intestine is cut between these clamps with cautery,

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and the clamps sterilized with the heat of the cautery. (Fig. 3.) This proximal end of the sigmoid is drawn out through the stab wound in the left rectus, where it is fastened to the various layers with a continuous lock stitch of small double chromic catgut. The first row fastens the peritoneum to the intestine, the second the aponeurosis and muscles, the third the skin, the skin being fastened by small interrupted chromic catgut. The clamp remains on the intestine and at the conclusion of the operation is strapped on to the patient with adhesive straps to be removed twenty-four or forty-eight hours later, as is convenient.

(g) Next step in the operation then is to turn in the distal end of the sigmoid with purse string, trim the fat of the mesentery from its sides, pass a strong thread through the eye of the rectal tube and through the walls of the intestine, pick up the two sides of the walls of the intestine and have an assistant draw on the tube from below, by which the sigmoid is inverted and drawn out through the anus. (Fig. 4.) One or two sutures may be passed across the peritoneal sur-



FIG. 13.—Space from which rectum has been removed, connected with abdominal drainage canal through which irrigation may be conveniently made.

face of this inverted end so as to prevent reduction of the inversion. A clamp or safety pin on the protruding gut outside the anus does this very effectually.

(h) The next step of operation consists in the restoration of unbroken peritoneal cavity, which is done in the following order: The space external to the point where the sigmoid comes through the left rectus muscle should be closed by suture, bringing the anterior, posterior and lateral peritoneal surfaces together with a firm line of sutures up to and including the mesentery of the sigmoid. From this point the posterior parietal peritoneum is drawn over the raw edges where the mesosigmoid has been cut. This line of sutures continues down to a point where it is necessary to insert the

drainage. (Figs. 5 and 6.) If the patient is a woman, an assistant passes a pair of large forceps to the upper end of the vagina. The posterior vaginal wall is cut on the forceps and drawn out through the vagina, leaving an ample end in the space beneath the peritoneum and above the end of the inverted bowel. (Fig. 7.) Then the running suture is continued down across the cul-de-sac, closing all spaces. In some instances we have sutured the uterus in the hollow of the sacrum with its broad ligaments.

If the patient is a man, the peritoneum is sewed down to the point where it is necessary to insert the drain. A large cigarette drain is placed down to the hollow of the sacrum above and back of the inverted rectum. The running suture is continued by gradually drawing in the loose peritoneum

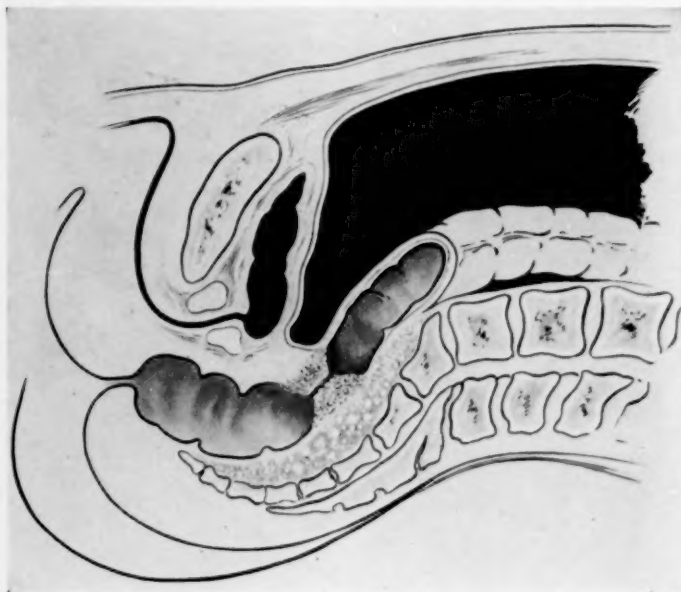


FIG. 14.—High rectal cancer producing stricture.

from the sides of the narrow male pelvis, coming forward toward the abdominal wall until finally all the distance is covered and there is a diaphragm of peritoneum which completely separates the general peritoneal cavity from the drainage canal. (Fig. 8.) In other words, the drain is in an extra-abdominal tube

of peritoneum. This drain is allowed to remain until the second operation, both for the purpose of drainage and to be used as a landmark. The main incision through the right rectus is now closed and protected from the future colostomy opening by a collodion dressing made up of one layer of gauze fastened to the skin of the abdomen, between the two cuts, by collodion, and this covered by a layer of gutta-percha and this again covered by another layer of gauze held by collodion. Finally an additional tube drain is placed in the rectum beside the protruding inverted sigmoid. A safety pin holds the tube in and the intestine out. (Figs. 6 and 7.)

The second, or removal operation, is now a minor affair for the following reasons: First, we are through with the fecal current by having a permanent colostomy. We have destroyed all possibility of serious hemorrhage and

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resultant shock by ligation of the superior hemorrhoidal artery. We have removed all the difficulties attending the higher parts of the operation by pushing down all the fat and connective tissue within easy reach of the lower field. We have finished with the peritoneum and have made a clean closure by which the patient is protected from all kinds of intra-abdominal complications.

A marked cedema around the rectum seems to take place as a result of devascularization and drainage in the neighborhood, which makes the complete enucleation of the rectum and all surrounding tissues remarkably easy. It is performed as follows:

In the female the operation may be done by splitting the vagina according to Murphy's method, which is the simplest and quickest way, requiring only about two minutes to do the complete removal. Or the vaginal wall may be left, the coccyx removed, the fingers passed up between the vaginal wall and rectum until it has reached above the end of the inverted bowel and then, with the fingers curved to the

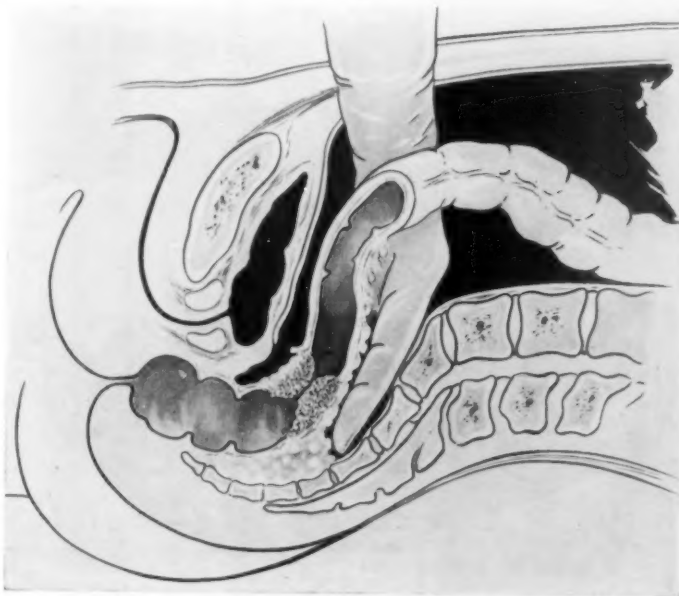


FIG. 15.—Sigmoid has been mobilized as in Fig. 2. Peritoneum around the rectum has been cut, the bladder separated from rectum down to the prostate. Fingers of left hand being insinuated between rectum and sacrum down to point of coccyx.

palm, the entire growth is peeled out with astonishing ease. (Figs. 9 and 10.) There is no bleeding except in the lower areas near the anus. The wound is now packed with a long continuous gauze sponge which controls any little oozing, takes up the sepsis, and the operation is completed.

In the male the coccyx is removed, the fingers insinuated between the end of the sacrum and the rectum, muscles on the sides are grasped and cut and the inverted bowel is brought down ahead of the fingers, which in this instance are directed away from the spine. (Figs. 11 and 12.) After the operation the entire cavity wall is easily seen and is packed with gauze lightly. The pack is left about three or four days and is removed. The upper

drain is removed and irrigation is made by running a catheter down through the front drainage canal, irrigating out backwards. This is the easiest way we have found to take care of these wounds. I have tried a number of these cases by partially suturing these wounds, but I have about reached the conclusion that if only the coccyx is removed, it is just as well to leave wound wide open. (Fig. 13.) Patient is on his feet in two weeks and there is never any complication in the way of obstruction of drainage before wound is completely healed. It, of course, is a matter of several weeks before the wound is completely closed.

Operative Measures for Relief of Cancer of the Upper Rectum or Rectosigmoid.—The first operation for removal of cancer located at the recto-

sigmoid junction, and which involves the peritoneum and produces a stricture (Fig. 14), is performed as follows:

(a) The sigmoid is mobilized as in the previous description for removal of the cancer of the lower rectum with the addition that the separation of the bowel and perirectal tissue in the hollow of the sacrum is carried

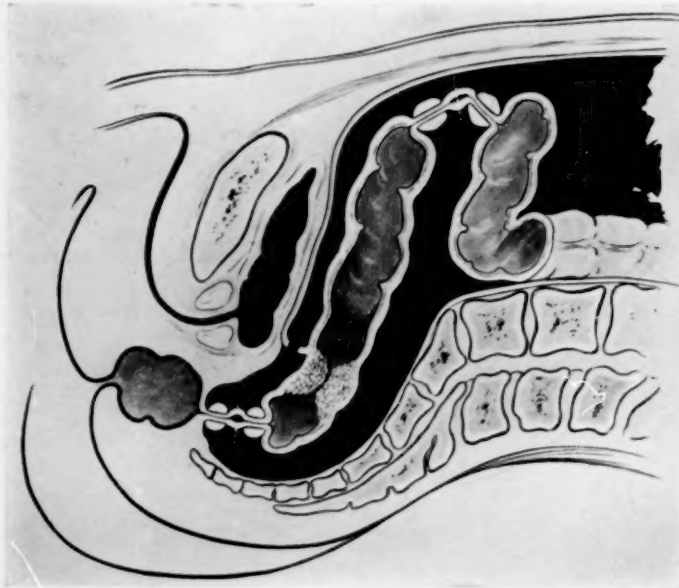


FIG. 16.—The freed bowel is doubly clamped above by Payr's clamps as in Fig. 3, and severed. Below, it is doubly clamped by long-handled clamps and severed, after which intestine with growth is removed.

down to the end of the coccyx and the rectum is separated from the bladder down to the prostate. (Fig. 15.)

(b) The sigmoid intended for the colostomy opening is seized by the Payr's clamp which has been inserted through the left rectus opening, just as in the operation previously described for removal of cancer of the lower rectum. Another clamp is placed immediately below it, passing through the main abdominal incision, intestine is cut, both clamps sterilized with cautery, the proximal end is brought out and colostomy completed just as in the other type of operation. The rectum is drawn up taut, the bladder is drawn forward, a large hysterectomy clamp grasps the rectum down as close as possible to the sphincter, approximately an inch or two, another clamp is placed just

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above it and the intestine is cut between the two. (Fig. 16.) By this means the cut is about two inches below the growth. All of the distal part of the sigmoid, most of the rectum, all the fat and tissue in the hollow of the sacrum, along with the growth, are removed completely at this operation. The handle of the lower clamp on the rectum is included in the same peritoneal tube which carries the large cigarette drain. (Fig. 17.) This clamp is removed in forty-eight hours.

In these cases, after the growth with the upper rectum has been removed from above and only a short piece of rectum is left, the stub of the rectum, after the completion of the operation, should be cleansed and packed with gauze.

In high recto-sigmoid cancer, in which we have completed the operation of removal of the growth at the first operation, and have only to remove the lower segment of the rectum at the second operation, we cut back through the sphincter to the tip of the coccyx, passing two or three fingers up to the end of the mucous membrane, peeling it

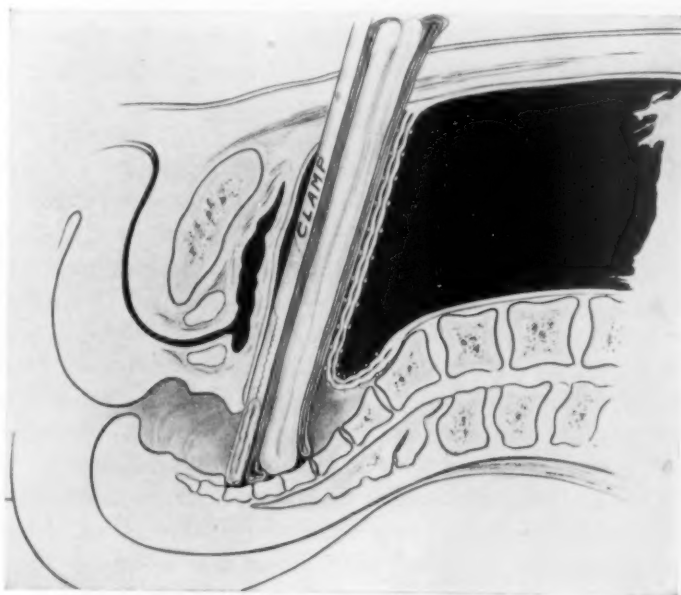


FIG. 17.—The handle of clamp holding stub of rectum is brought out through peritoneal tube with cigarette drain.

down to the anus, either with or without the removal of the sphincter muscle. In this way the contour of the buttocks and perineum remain unchanged by the operation except that the rectum has been removed. The question of drainage is a little more difficult, for drainage must be kept up in all these cases until the cavity in the hollow of the sacrum has filled.

If the contour of the anus and gluteal regions are to be preserved, special attention must be given to the drainage. After the temporary drain put in at time of operation has been removed about the third day, a large rubber tube is passed through the abdominal wound and out through the anal wound. One side of the tube is cut out at the angle of the abdominal tube with the anal tube, so that drainage may take place either way. A short tube of the

same size is placed in the anal wound and pinned to the long tube. This extends up three or four inches and helps to keep the lower wound open for a few days and also drain area in the hollow of the sacrum. This is irrigated by passing the solution through the tube coming out through the abdominal side and out through the other wound. In about a week or ten days, the short tube is removed, safety pin is placed in the upper end and lower end. Irrigation is continued until the lower canal begins to fit snugly around the tube. Then Dakin solution is used for a week or such a matter, being held in by clamping the lower tube. A few days later, a smaller tube of same kind is inserted and Dakin's solution continued. Finally a very small tube, which is made a half tube at its centre, is used. The irrigation, first with water and then Dakin's solution, continues. Finally the lower end of the tube is cut off and upper one gradually withdrawn, Dakin's solution being inserted from upper wound and made to run out through the lower wound as long as it will. This produces the most ideal result in that there is no deformity of the gluteal regions, although it requires a great deal of time and care in completing.

Results.—In an experience of more than 100 cases of cancer of the rectum, surgically treated, thirty-seven have been treated by the method of completing the major procedure first in the two-stage operation. Of these there have been two deaths, one from shock because of the far advanced state of the cancer, removal of which resulted in tearing the internal iliac vessels, also tearing of the ureter. The other was due to deficiency in kidney function, the patient dying of uræmia, about a week after operation, which gives us a mortality of 5.4 per cent. This, of course, is too small a number on which to base statistics when we consider the mortality rate alone, but in our experience when we take into consideration almost complete absence of shock and complications, I feel sure that any multiple of this number of cases would probably bring equally as good a record, if not better.

Operability.—By this method of doing the major part of the work from the abdominal side and removal of all possible elements of danger at the first operation, which could complicate the second operation, we should consider no case of cancer of the rectum inoperable except insofar as it involves other important adjacent organs or metastatic areas.

THE SURGICAL RELIEF OF INTESTINAL FOCI OF INFECTION IN CASES OF ARTHRITIS DEFORMANS

By REA SMITH, M.D.

OF LOS ANGELES, CALIF.

IN 1915 the writer reported before the Surgical Section of the American Medical Association, a series of fourteen cases of chronic arthritis operated upon for the removal of an intestinal focal infection. Of this list two have died, four are untraced, three are not improved, one has had a complete arrest of the disease, but is unable to walk on account of joint fixation. Four are restored to normal activity. We attribute our failure to show a higher percentage of cures to our surgery. These early patients were all operated upon with the Lane technic, which was followed in a large proportion of cases by intra-abdominal adhesions which defeated the surgical aim by preventing the relief of the intestinal blockade. We learned in 1915 the cause of these adhesions and a simple way to avoid them, and have not been troubled by recurrence of stasis since then, even when an operative procedure of the Lane type was used.

From our observation of these patients since 1913, we are of the opinion that the disease has its origin in a focal infection in the intestinal tract due to an unbalanced or perverted intestinal flora made possible by the failure of some part of the ileocaecal coil to empty itself properly.

Infections of the teeth and tonsils are undoubtedly the cause of many cases of arthritis, especially of recent origin, and their removal quickly clears up the symptoms. But in chronic cases the removal of tonsils and teeth has, as a rule, very little permanent effect. The reason being that an intestinal infection has taken place and a larger focus developed, so that then the clearing up of the head foci hardly affects the load of infection at all.

In the examination of the intestinal tract of more than one hundred cases of chronic arthritis with the X-ray, we have been surprised at the similarity of the picture of the ileocaecal coil, and have come to the conclusion that the typical soil for development of arthritis is a congenital mobile cæcum, which has been tacked back to the side wall of the abdomen by nature in an effort to lift up and anchor a prolapsing organ.

By a reduplication of peritoneum starting at the right colic artery and extending to the parietal peritoneum over the right kidney, the colon is rolled and folded so that it gives the appearance of an hour-glass, with the cæcum thin-walled and toneless. This seems to be an exaggeration of the condition first described by Jabez Jackson and known as Jackson's membrane. There is usually a binding down of the ileum somewhere in its terminal eight inches, increasing the torsion in the ascending colon so that the physiological function of the colon is crippled and the cæcum becomes an inert sac, which does not empty itself. This sac constantly filled with culture medium becomes

infected with streptococcus, either from a head infection or from the terminal ileum, which is the natural habitat of the streptococcus veridens. The streptococcus becomes then the predominating colon organism and we have an overbalanced or perverted flora resulting, which in its turn becomes the focus of infection and which keeps up the arthritic disease caused by the original head focus or itself becomes an original focus and brings about the disease.

The last thirty cases of this series have all had preliminary stool examinations by Barrows and have all shown amœbæ and flagellate protozoa in great numbers. I have been of the opinion that they had to do with the stasis and played a secondary rôle in the infection, perhaps by furnishing culture media for bacterial growth, or by their passage through the mucous membrane furnished a portal of entrance to the circulation for bacteria. But Ely reports in the *California State Medical Journal* of February, 1922, the finding of amœba histolytica in the head of a femur removed from a patient with arthritis deformans. This was confirmed by Kofoed in the same journal. The finding of this organism *once* does not prove that it is a cause of arthritis, but it is significant, and of especial interest to me because of its intestinal origin. We *do* know that these parasites are present in all of our cases of chronic arthritis examined for them and that they decrease very rapidly under the administration of liquid paraffin.

We have endeavored by medical and surgical means to eradicate this focal infection and I have a group of sixty-eight operative cases which I will present for your consideration. We will divide the list into two groups: The old ones operated upon before October, 1917, and the *new* group, operated upon since 1920, the interval being due to the break in routine work made by the war.

Of the old group comprising thirty cases, we have ten who were bed-ridden and helpless when operated upon, now able to work with their hands and be self-supporting. These all had partial colectomy or ileosigmoidostomy. A good many of the cases we have been unable to trace and a good many have died from intercurrent disease. The patient whom I demonstrated in 1915, one year after her operation, is still earning her living in Los Angeles as a general nurse (although she is over sixty years old) and has had no recurrence of symptoms.

In the new list comprising thirty-eight cases operated upon since June, 1920, we have eight Mayo right-sided colectomies, two ileosigmoidostomies and twenty-eight plastic operations on the ileocaecal coil designed to restore the impaired physiological function of the cæcum and do away with the sac that breeds the focal infection. There is usually an immediate alleviation of the symptoms of pain, swelling and joint immobility, which unfortunately is not permanent, because the patient still has a perverted intestinal flora and the operation is often followed by a rather severe joint reaction. However, with restricted diet, based upon a bacterial analysis of the stool, liquid

INTESTINAL FOCI OF INFECTION

paraffin and abdominal support, the flora gradually returns to normal and the patients progressively improve.

If there is no mechanical intestinal abnormality, but instead a general colon sluggishness, the after-surgical treatment, without the surgery, will produce the same result. We have in a number of cases had great symptomatic improvement treated in this manner without any surgical procedure. Other patients treated medically without any improvement, have had an immediate relief of symptoms after a surgical procedure to remove the intestinal blockade, and then returning to the same medical régime.

The most striking immediate results follow the removal of the right colon, and here lies the proof of the colonic origin of the disease. The removal of the right colon deprives the patient of his filter and for ten days there is practically no water absorbed by the intestinal tract. It becomes necessary to give this patient water under the skin to prevent dehydration and our routine is a quart of salt solution daily by hypodermoclysis until the quantity of urine jumps from 1000 to 2000 c.c. This happens usually from the tenth to the twelfth day. During this ten-day period our patient makes a wonderful recovery from joint trouble. In forty-eight to seventy-two hours the swelling disappears and the joints become more and more movable and the pain entirely disappears, but on the day the urine doubles, showing that the intestinal tract is again absorbing water, the joint symptoms recur. The perverted flora is still able to act as a focal infection and the joints then clear up slowly as the flora returns to normal. The ileosigmoidostomy cases act in the same way because we use a tube through the sigmoid into the ileum and no water reaches the cæcum. The cases that are operated upon to restore function by releasing constricting bands and correcting pulls and counter-pulls, that prevent the physiological contraction of the muscle walls of the cæcum, do not have this spectacular early remission of symptoms, but slowly get better and as the unbalanced intestinal flora regains its normal balance the joint symptoms disappear.

The interference with physiological function of the cæcum is easily demonstrated by dividing the constricting band with a sharp knife at its junction with the parietal peritoneum. The ascending colon immediately rolls out until three or four inches separate the ends of the divided band and the cæcum regains its normal color and contracts upon mechanical stimulation. We think that the interposition of tissue is the most important step in preventing recurrence and use free omental grafts to fill in all gaps and cover all denuded surfaces.

We have found the unpuckered mesoappendix spread out and turned over towards the midline most useful in covering the denuded surface developing on the mesentery of the ileum upon the division of a "Lane's kink," and think that again the interposition of tissue is most important in preventing a recontraction of peritoneal surfaces and a redevelopment of the kink. We always drain with a flat rubber drain for twenty-four hours, after breaking up adhesions around the colon and thereby save our patients from a wide-

spread local peritonitis which is in itself likely to cause adhesions and interfere with the results of the operation.

In this new group of thirty-eight cases we have had eight in which the colon, after freeing, was such an inert bag that we deemed it better to remove than to trust to its regaining its tone. Two who had a good colon and a *small* intestine block only were short-circuited, which operation is only safe when the colon has good tone and is unobstructed. Twenty-eight had a simple operation amounting to the removal of the appendix, releasing bands and covering denuded surfaces. There were three deaths in the surgical period in this series, two of heart block on the fifth day after operation, coming on suddenly in the course of an uneventful surgical convalescence, both having crippled hearts from many recurrent acute attacks of their old infection. One died from a low-grade wound infection.

The joints become amenable to orthopædic treatment as soon as the pain subsides, and operations and manipulations can be carried out without fear of lighting up another attack of acute inflammation, which always hampers the orthopædic surgeon when he attempts any radical procedure in the presence of the infection.

In conclusion, we believe that we have clinical proof that chronic polyarthritis is the result of a focal infection located in the ileocæcal coil. That no study of a case of arthritis is complete without a careful investigation of the gastro-intestinal tract, especially of the ileocæcal coil for both motility and mobility. In the event that a pocket exists in the intestine, the rational procedure is first an abdominal operation to straighten out bad mechanics and restore function to the cæcum, a prolonged medical régime to restore the unbalanced intestinal flora to normal and then such orthopædic procedures as are necessary to restore function to damaged joints.

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- ² Surgery, Gyn. and Obstetrics, November, 1916.
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LIGATION OF THE AORTA*

NECROPSY TWO YEARS AND ONE MONTH AFTER OPERATION

By GEORGE TULLY VAUGHAN, M.D.

OF WASHINGTON, D. C.

SEPTEMBER 27, 1921, the patient was examined and demonstrated to a class of medical students. The physical signs were about the same as at the last examination, except that the whining sound noticed before was no longer heard. He was at work and expressed himself as feeling perfectly well.

December 18, 1921, patient examined on account of pain in lower part of left side of the chest, thought to be a slight pleurisy. Otherwise no change observed.

January 27, 1922, the patient was taken with violent pain in the abdomen, almost collapsed, and was taken to hospital, where after a cystoscopic examination a diagnosis of displacement of the right kidney and obstruction of the ureter was made. An operation was undertaken to relieve this trouble, the kidney was exposed and found to be pushed downward by a large pulsating mass and the operator thought it wise to proceed no further with the operation. So the wound was closed around a drain. There was a slight bloody discharge from the wound during the next two weeks and the patient gradually weakened until his death, February 25th, two years, one month, and two days after ligation of the aorta.

Necropsy.—Numerous adhesions about the stomach and great omentum, vessels of latter dilated. Inferior mesenteric artery and branches dilated considerably. The peritoneum over the aneurism was unbroken and there was no evidence of rupture or the escape of blood to account for death. The aneurism sprang from the posterior wall of the aorta by a large mouth opposite the origin of the superior mesenteric and renal arteries, and extended slightly to the left, but chiefly to the right, behind the peritoneum, eroding the bodies of the second, third and fourth lumbar vertebræ and involving the sheath of the right psoas muscle. It measured seven inches from above downward and six inches transversely and was filled with a large, firm, reddish-white clot, no fluid blood except a little at the lower end in the psoas sheath. It was a very large, hard clot and did not seem to interfere with the lumen of the aorta.

The ligature was found surrounded by thick connective tissue which completely concealed it from view. The loop measured one-fourth of an inch in diameter; there was no sign of absorption and it was buried in the coats of the aorta, having cut through the intima on the left, but on the right side was separated from the lumen of the vessel by the intima. The left common iliac artery was open and continuous with the lumen of the aorta above the ligature, while the right common iliac was completely closed by organized clot or connective tissue. No atheromatous patches were found in the aorta.

* Read before the American Surgical Association, May 2, 1922.

LIGATION OF THE INTERNAL ILIAC FOR ENORMOUS GLUTEAL ANEURISM*

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CIRSOID ANEURISM OF THE SCALP

ANY of the branches of the internal iliac or hypogastric artery may become aneurismal. They are intra-abdominal or intraperitoneal, except those that occur in the peripheral branches, as the gluteal, sciatic, obturator, pubic, etc. Those of extrapelvic origin often extend into the pelvis, and some of intrapelvic origin may be extrapelvic as well. The sacro-sciatic notch forms the groove between the sacs. They are described as pelvic aneurisms but are more commonly designated as aneurisms of the buttocks. These dilations or extravasations are the gluteal or sciatic arteries and occur more frequently than those of the other branches.

Iliac aneurisms appeared eleven times in Crisp's classic group of 551 aneurisms, five of these being of the internal iliac, making less than one per cent. of all aneurisms in his collection. The incidence of gluteal aneurism is, therefore, a much smaller per cent. Of twenty-one patients reported by Ott¹² with aneurisms exclusive of thoracic aneurisms operated at the Mayo Clinic between January, 1907, and November, 1918, in only one was the internal iliac ligated. Rupp,¹³ in 1907, was able to collect forty-five cases. From 1916 to date only five new cases of gluteal aneurisms have been reported in the available literature.

For the most part gluteal aneurisms are traumatic from direct or indirect violence, however, no history may be obtained of injury and they are described as spontaneous. Aneurisms of the buttocks are ordinarily of the circumscribed traumatic type. Of the twenty-eight cases mentioned by Matas¹⁰ in his very comprehensive article, twelve were due to wounds (stabs) and twelve to ruptures or lacerations caused by fracture of the pelvis or contusion, falls on the seat, etc. Goldammer⁶ reports one case developing shortly after being beaten with a board. Matas further says "the gluteal artery is more frequently injured by direct wounds (stabs); the sciatic by falls on the ischium or seat, which fractures the pelvis or tears the artery at its exit from the sacro-sciatic foramen." In Rupp's collection of forty-five gluteal aneurisms, twenty-two were of traumatic origin and twenty-three spontaneous. Eight of these twenty-three were indirectly associated with trauma. Indirect traumatism, including the rupturing effect of sudden, violent efforts, as lifting, wrestling, are to be regarded as exciting causes only when pathological conditions, such as atheroma exist as a predisposing condition. The left side is more frequently involved but they may be bilateral. The vast majority occur

* Read before the Southern Surgical Association, December 13, 1921.

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in men and are most frequent between the twentieth and fortieth years. The size of the aneurism may vary from that of a small apple to that of a huge tumor, which fills the larger part of the pelvis and externally appears as enormous tumor as large as an inverted salad bowl.

The symptoms vary according to its size, origin, proximity to, and pressure upon, the adjacent structures. An expansile, pulsating tumor appearing after traumatism is suggestive of aneurism. A thrill may be felt or on osculation a



FIG. 1.—Gluteal aneurism, treated by ligation of the internal iliac artery.

bruit may be elicited. The spontaneous tumors are slow in developing but the traumatic are usually rapid in growth and are large and diffuse. On account of the pressure on the sciatic nerve, the early symptoms are often considered to be a sciatica. It is only when a tumor can be made out that the diagnosis can be certainly established. Aneurisms of the sciatic branch are more movable than aneurisms of the gluteal and are in closer proximity to the ischium. These aneurisms when they do not pulsate or are filled with hard clots may be mistaken for osteosarcoma or lymphosarcoma, abscess or other tumors. Röntgen-ray and exploration with aspirating needle often aid in determining the exact nature of the condition. This, together with a careful history, accurate physical findings and necessary laboratory data, will usually give the diagnosis.

Matas warns that "these large gluteal aneurisms tend to rupture spon-

taneously and sometimes choke up the thigh with massive extravasations of blood, causing death from hemorrhage very rapidly." The prognosis is excellent with modern surgical methods of to-day.

The older methods of treatment have all given way to surgical treatment. Coagulation by the injection of boiling water or chemicals, galvano-puncture, etc., have been discarded in favor of modern surgery. The first ligation of the internal iliac was done by the extraperitoneal route by Stephens, of Vera Cruz, in 1812. Of twenty-six ligations of this vessel on the Hunterian plan, eighteen were fatal. It was a dangerous operation as only a few were done antiseptically. D'Antona,³ of Naples, published all the reported cases of ligation of this artery from 1869-1903. There were in all twenty-five cases with fifteen recoveries. Many of these were in the preantiseptic era which explains in part the forty per cent. mortality. Following this there was introduced the now old operation, a modified Antyllian as performed by Syme as the method of "intrasaccular ligature," with a mortality of sixteen and sixty-six hundredths per cent. in the fourteen cases reported by Delbet. The ligation of the internal iliac by the intraperitoneal route at the present time is a comparatively simple and satisfactory procedure. This method, unfortunately, will not cure all cases as the results are sometimes uncertain. Gillette reports one case with recurrence after seven years, which necessitated reoperation and ligation of the external iliac for a cure. These results can still be further improved with modern technic; that is, a combination of ligation of the internal iliac whether permanent or provisional, with free excision of the sac and its obliteration by sutures which is described by Matas, as obliterative endoaneurismorrhaphy. This technic is well illustrated and described in a case reported by Abbee.¹ This is the method of election in well-developed aneurisms with a definite sac wall "provided prophylactic hæmostasis can be obtained by preliminary intraperitoneal ligation or temporary compression of the internal iliac." The wisdom of this procedure is illustrated by a case of large traumatic gluteal aneurism reported by Frost.⁵ It was thought that it could be controlled by a buttock incision, but when the fascia was incised, "there was a sudden spurt of arterial blood rising upward some four feet." Only the prompt packing of the sac with gauze and immediate ligation of the internal iliac, for which he was prepared, saved the life of this patient and also cured the aneurism. The same prophylactic hæmostatic method should be adopted in the treatment of the acute traumatic aneurism without definite sac wall, and the injured artery should be tied or the sac sutured as the case may demand.

The small traumatic aneurism or the small pathological aneurisms which are well defined outside of the sacro-sciatic notch are best treated by exposing the sac in its entirety and then extirpating it. Such a case of small traumatic aneurism was successfully operated by Krische⁸ under lumbar anæsthesia. In gluteal aneurisms which begin in the pelvis, ligation of the internal iliac as near the aneurism as possible with continuous external pressure, approxi-

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matting the empty sac wall until agglutination has taken place, may be sufficient to produce a permanent cure.

The ligation of the internal iliac or its branches does not compromise the nutrition or vitality of the lower extremity. This is due to free anastomosis of its branches and abundant collateral circulation. Quoting from Professor Owen (Gray's Anatomy): "In ligation of the internal iliac, collateral circulation is carried on by the anastomosis of the uterine and ovarian arteries; of the opposite vesical arteries; of the hemorrhoidal branches of the internal iliac with those from the inferior mesenteric; of the obturator artery, by means of its pubic branch, with the vessel of the opposite side and with the epigastric and internal circumflex; of the circumflex and perforating branches of the profunda femoris with the sciatic; of the gluteal with the posterior branches of the sacral arteries; of the iliolumbar with the last lumbar; of the lateral sacral with the middle sacral; and of the circumflex iliac with the iliolumbar and gluteal."

There are so few enormous gluteal aneurisms reported in the literature which have been successfully treated, that the following case is submitted:

File A 12295. A white woman, sixty-five years old, complained of intolerable pain in her right leg a throbbing tumor of the right buttock. She had enjoyed comparatively good health all of her life, having no serious illness or injury. For a number of years she had been having trouble with cramp-like pains in the calf of her right leg and would have to have it massaged before she could walk. This became gradually worse. During the six weeks prior to her entrance into the hospital, she had three or four attacks of excruciating pain in the calf of her right leg, referred up the posterior thigh to the right hip, necessitating morphin for relief. The pain is paroxysmal in character, during which time she is unable to move her right leg. She is never entirely free of pain in her right leg.

For the past three years she has noticed a swelling and throbbing in the right buttock, like a "heart-beat." This seemed to gradually increase in size, but never gave much trouble. During the past two weeks it has rapidly increased in size until it is as large as an inverted salad bowl. The pain in the swelling and in the leg has been so severe the past two days that she has had to be in bed and has been unable to move her right leg. Prior to that time she was up and about, walking with a slight limp. She has never had any swelling or discoloration of her limbs.

Physical Examination.—Patient is a rather poorly nourished, white female, about sixty-five years of age and weighing 106 pounds. General physical examination was negative, except for the condition of her heart and right buttock. There is a soft, blowing, systolic murmur, heard better at the apex and transmitted to the right axilla. Pulmonic second sound was accentuated, but no enlargement of the heart was made out. Rate, 115; temperature, 99.2°; respiration, 24.

There is a large, diffuse, pulsating, expansile tumor of the entire right buttock. The tumor is soft, compressible, and a thrill and a bruit are made out over its entirety. The movements of the knee and the right hip are free but painful (Fig. 1).

Laboratory Examinations.—(1) The urine was negative except for a trace of albumin and an occasional hyalin and granular cast. (2) Blood group (Morse technic), Type 2. (3) Wassermann reaction (acetone insoluble antigen) 2 plus;

cholesterin antigen negative. (4) White blood-cells, 6200; hæmoglobin, seventy-five per cent.

Diagnosis.—Aneurism of right buttock, probably of gluteal artery; compensating mitral regurgitation.

Patient was very weak and in poor general physical condition, not having slept or eaten much for the last two weeks. Pain was so severe that she had to have morphin every four to six hours for relief. She slept but little and her mental condition was confused.

She was under observation in the hospital for one week with abundant food, fluids and rest. It was planned to ligate the internal iliac artery and possibly do an intrasaccular suture (endo-aneurismorrhaphy), as described by Matas and effectively demonstrated in one case by Robert Abbee, and then if necessary do a blood transfusion. At the end of the week her general condition was somewhat better but the tumor was still apparently enlarging, so an immediate operation was advised.

Operation.—September 10, 1921. In moderate Trendelenburg position, and through a right rectus incision with the intestines well packed off, the right internal iliac artery was exposed without difficulty. It was found to be as large as one's little finger and a thrill was elicited by the examining finger. By pressure upon it the pulsation in the tumor was stopped. The external iliac was normal in size, as was the common iliac. Two heavy silk ligatures were tied around the internal iliac one-fourth inch from its origin and another heavy silk ligature was placed one-fourth inch lower down. The posterior peritoneum was sutured over the vessels. The appendix was seen; it appeared normal and was not removed. The wound was closed without drainage. In order to facilitate the agglutination of the wall of the aneurismal sac it was emptied by firm pressure and a large pad was very tightly strapped over it. After the operation the pulse was 104 and of good volume. The pain in the right leg was relieved for the first time in over two weeks.

The convalescence was uneventful. The temperature, which was 104° the day following operation, gradually subsided to normal on the sixth day. She required morphin only occasionally for the first few days for abdominal discomfort. There was never a return of the excruciating pain in the right leg. The pulsation of the tumor, which previously lifted the body perceptibly from the bed, became quiet and the bruit and thrill disappeared entirely.

It had been planned to do an obliterative endo-aneurismorrhaphy as a second stage following the ligation of the internal iliac, but after the aneurismal tumor was so completely stilled by the former procedure it did not seem necessary. It is agreed that the methods introduced by Matas in the treatment of aneurisms are ideal in an artery in continuity; but in a location like the buttock, a deliberate incision into such an enormous blood tumor, which this case presented, without preliminary circulatory control, seemed unwise.

The patient left the hospital on the nineteenth day, and has been up and about on crutches since that time, gaining in weight and strength and is entirely free of pain. When relieved of her intolerable suffering, her mental condition returned to its normal state.

CIRSOID ANEURISM OF THE SCALP

This curious, rare, disfiguring and often dangerous affection was classified by Virchow among the blood-vessel tumors, and has been called "Ranke-mangiom" or "angioma arteriale racemosum," or aneurism by anastomosis. The uncertainty regarding its morbid anatomy and etiology makes it a malady which needs further study.

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According to Matas¹¹ the process shows itself as a subcutaneous swelling made up of a pulsating network of arterial sinuses, from which radiate pulsating vessels that can be distinguished as individual trunks. However, it is difficult to establish whether these trunks originally contained arterial or venous blood. It is supposed to start as a widening or dilating of the branches of a particular arterial tree. It most commonly affects the vessels of the face and scalp; next the forearm and hand. The widening, thickening and lengthening of the arteries extend ultimately to the finest capillary. Traumatism or pregnancy has been known to play a part in exciting the transformation of the vessels. Lexer is of the opinion that some developmental fault which affects the particular vascular territory concerned lies at the bottom of the process.

The diagnosis is made almost instantly by sight, while the touch confirms the impression of the arterial character of the vermiform tangle of dilated blood-vessels. A systolic blow and thrill may be transmitted to the palpating hand. A systolic murmur may be present and pressure on no one point obliterates the bruit.

The complications are many. There is a distressing thrill and pulsation, and there may be subjective symptoms of noises in the head, dizziness or fainting spells. There may be pain from inflammatory involvement of adjacent nerves. The overlying skin sometimes becomes ulcerated and produces fatal hemorrhage or severe resulting infection.

No form of treatment has met with uniform success. Central ligation of the main artery has proven unavailing or has given only temporary relief. Effort to produce solidification of the vessels and thrombosis by injection of alcohol and boiling water is not without danger. Wyeth reports a case involving half of the scalp cured by the injection of boiling water. At repeated operation, parts of the scalp bearing the aneurism have been removed, allowing the wound to heal before each successive operation. Another method was to excise the scalp bearing the aneurism and later fill in the gap with skin graft. The best method, however, is complete extirpation with ligation of all the radiating trunks. It is the ideal method, but, unfortunately, often impossible where much of the scalp is affected.

Case Report No. A11564. A woman twenty-five years of age, presented herself, complaining chiefly of a pulsating tumor of left scalp. Ten years ago she noticed a small, soft tumor, the size of the end of her finger, in the left parietal region near the median line and posterior to the occipito-parietal suture. No history of injury antedated the appearance of the tumor. There was no pain, but it was slightly tender to pressure. It never gave any trouble, but gradually increased in size until the present time. It is now about the size of a flattened goose-egg, with tortuous branches spreading out to the zygomatic arch on the left, and across the median line to the opposite parietal region and posteriorly toward the occipital region. For the past two or three years she has had pain of a more or less dull, throbbing character, especially marked in the eyes and in the frontal and occipital regions. It is usually worse when lying down. She notices the throbbing more when she reads or sews much at a time. Occasionally, she has a feeling as if something is pulling her hair.

Her general health otherwise has been excellent. Menstrual history is normal. She has been married for five years and has one child, three years of age. She has had no miscarriages. She had measles, mumps, whooping cough, chicken-pox and malaria when a child. She had influenza about three years ago. There is no history of venereal infections or injury. A small fatty tumor was removed from in front of the right ear three years ago.

Father, mother, three brothers, two sisters, husband and one child are living and well. Father has a fatty tumor of neck. One brother has a deformity of lip. Family history is negative for tuberculosis, cancer or nervousness.



FIG. 2.—Cirroid aneurism of the scalp.

General physical examination was negative except for the scalp. The left anterior half of the scalp is covered with a large tumor-like aggregation of dilated, tortuous, pulsating, bluish-tinted, elevated blood-vessels (Fig. 2). Just to left of median line is a larger mass, size of a child's hand, with tortuous pulsating branches radiating out to the left zygomatic arch and across the median line to the right parietal region and posterior toward the occipital region. It feels like a bunch of worms or a varicocele, except it is pulsating, expansile, and a thrill is felt and a bruit heard. Pressure on the external carotid artery lessened but did not stop the pulsation. Röntgen-ray of head was negative for erosions along the longitudinal sinus. Laboratory examination of the blood and urine was negative.

Diagnosis.—Cirroid aneurism of the scalp.

Operation.—April 1, 1921. Patient was placed face downward with the head at the end of the table and a tight hæmostatic elastic band was applied around the head. A transverse incision was made, inch by inch, from the left middle temporal region to the right parietal region, well in hairline. The incision was made through the skin and epicranial aponeurosis skirting the growth posteriorly, making a slight U-shaped flap with the base anterior. The flap was reflected from the cranium forward, requiring many hæmostats and ligatures because of the free anastomosis with the deep vessels. The field was made comparatively dry as we proceeded. The entire tumor was ligated, posteriorly, the right occipital and anteriorly, the right temporal arteries were greatly enlarged but were not ligated. The wound was sutured in usual manner with one small tube for drainage. Oozing from the left end of the wound was controlled by iodoform gauze.

There was slight oozing for twenty-four hours, but this was not alarming. The eyes and face were somewhat swollen next day, which gradually increased, and the eyes were closed and face and neck were œdematous on the third and fourth days. This gradually disappeared under boric acid dressing and external applications of heat. The patient was dismissed from the hospital on the sixteenth

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day, with the wound practically healed, except a small area above the left ear. Eight months after the operation there is no evidence of a return of the trouble and the patient is entirely free of the throbbing headaches.

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PERIPHERAL NERVE INJURIES ASSOCIATED WITH FRACTURES *

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It is impossible to determine the frequency with which nerve injuries are associated with or complicate fractures. Undoubtedly many of the slighter injuries are not noted. Many of the severe injuries are not regarded as worthy of discussion because of spontaneous recovery of the paralysis. Such injuries, when they exist, increase and prolong so much the disability associated with the fracture that it seems advisable to report the series of cases included in this paper and to analyze those already reported, in order to determine if possible the most common lesions and to suggest a line of treatment based upon the data recorded, which will lessen the length of disability and decrease to the maximum the amount and extent of the paralysis.

The following cases have been studied in the different surgical services of the Presbyterian Hospital of Chicago. An abstract only of each case is here given. Fuller details will be found in the Transactions of the American Surgical Association for 1922.

CASE I.—*Left musculospiral paralysis* developing some weeks after fracture of the clavicle. Difficult to explain the cause of the rather late secondary paralysis. No lesion of the humerus. Final outcome impossible to determine because patient has moved and cannot be traced.

CASE II.—*Primary musculospiral paralysis.* Fracture of surgical neck of humerus and through lower epiphysial cartilage. Branch to supinator longus and extensor carpi radialis longior affected. Return of motion two months after injury. Complete spontaneous recovery.

CASE III.—*Left musculospiral paralysis.* Comminuted fracture of left humerus. Fracture plated. Date of onset of paralysis not definitely known, but probably a secondary paralysis. Nerve found adherent to bone at site of fracture and kinked. Surrounded by delicate adhesions. Muscle neurolysis. Complete recovery of motor power in six months. Small area of anæsthesia over dorsal web between thumb and index finger. Operation eight months after development of paralysis.

CASE IV.—*Primary paralysis of musculospiral nerve,* the paralysis persisting because the nerve is stretched over the lower end of the upper fragment of a spiral fracture occurring near the middle of the shaft of the humerus. Operation: Muscle neurolysis. No gross change in the nerve, although embedded in some rather delicate scar tissue at the site of the fracture. Not enough time has elapsed since operation, to permit of any return of function.

CASE V.—*Secondary paralysis of left musculospiral nerve.* Fracture junction of middle and lower third. Fracture compound—osteomyelitis with sequestrum formation. Wrist-drop developing fifteen weeks after insertion of intramedullary

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peg for non-union. Scar and callus inclusion cause of paralysis for paralysis was first noted when callus began to develop posteriorly.

CASE VI.—*Primary musculospiral paralysis.* Fracture of right humerus; transverse lower third; displacement outward of lower fragment. Nerve identified at time of operation for reduction of the fracture. Spontaneous recovery after six weeks.

CASE VII.—*Secondary musculospiral paralysis.* Wrist-drop not observed until several weeks after injury. Spontaneous recovery of paralysis.

CASE VIII.—*Right musculospiral paralysis,* first noted some time after accident. Nerve was, however, divided in antecubital fossa. Operation nine months after injury. Recovery after end-to-end suture. First signs of recovery six months after operation. Return of motion progressing rapidly.

CASE IX.—*Primary paralysis of musculospiral and median nerves left arm.* Injured by falling timber. Fracture of lower third of humerus. Branch to the supinator longus and extensor carpi radialis longior not affected. Musculospiral nerve found divided in antecubital fossa. End-to-end suture almost four years after the accident. Median nerve subsequently explored and found to be considerably thickened just above elbow and imbedded in a scar. Neurolysis.

CASE X.—*Primary paralysis of musculospiral nerve.* Fracture at junction of lower and middle third of humerus. Debridement of wound in treating fracture. Nerve found to be crushed. Death seventy-one days after injury from other wounds. Nerve found embedded in considerable scar and callus at that time.

CASE XI.—*Primary musculospiral paralysis.* Fracture of right humerus in lower third. Repeated operation for repair of fracture which finally united. Operation subsequently upon musculospiral which according to father's statement was not divided. Operation almost four years after accident. Musculospiral not divided; embedded in scar. Neurolysis—no improvement to date.

CASE XII.—*Paralysis of left musculospiral and ulnar nerves* following attempts at reduction of supracondylar fracture. Considerable manipulation required to reduce fracture. Shortly after manipulation paralysis was noted. Complete recovery five months after the reduction.

CASE XIII.—*Primary paralysis of left musculospiral nerve.* Supracondylar fracture with marked displacement forward and outward of lower end of upper fragment. Operation fifty-nine days after injury. Musculospiral nerve not divided. Thickened at site of fracture and adherent to underlying bone. Neurolysis. Examined two months after operation. Marked improvement in the paralysis.

CASE XIV.—*Primary right median nerve paralysis.* Separation of lower epiphysis with marked anterior displacement of lower end of upper fragment. Nerve surrounded by scar enlarged and indurated. Funiculi found passing through indurated portion. Multiple longitudinal incision of nerve. Muscle neurolysis. Eighty-five per cent. recovery.

CASE XV.—*Complete division of right median nerve* associated with supracondylar fracture of the shaft of the humerus. At operation the distal end of the proximal segment of the median nerve was found drawn in between the bone fragments. The nerve was freed and an end-to-end suture performed, with forearm in acute flexion.

CASE XVI.—*Contusion of left median nerve* associated with T-fracture of humerus. Pain noted over the distribution of median nerve immediately after the injury. Symptoms associated with the nerve injury at the present time are pain over distribution of the median nerve in the hand and tenderness. Atrophy is slight and might be accounted for by disuse and immobilization. Median nerve distinctly thickened for a distance of one and one-half inches at the site of the fracture. Spontaneous recovery is occurring.

CASE XVII.—*Late paralysis of median nerve*, sequel to reversed Colles' fracture of right wrist, with permanent anterior displacement of lower fragment. First symptoms of paralysis noticed eighteen years after the injury. Condition persisted until death, five years later, at age of fifty-five years.

CASE XVIII.—*Combined median and ulnar nerve palsy* sequel to oblique fracture of the upper end of left humerus, involving part of the epiphysis. Operation revealed ulnar nerve displaced and embedded in dense scar at the level of the healed fracture. Median nerve twisted 180°. Necessary to divide the ulnar nerve to free it from its scar involvement. End-to-end suture made. Median nerve readily replaced in normal position. No later inspection by surgeon, but letter from patient states great improvement in the muscles supplied by the nerve directly involved.

CASE XIX.—*Injury to ulnar nerve*, associated with fracture of the right radius in its lower fourth, with fracture of the styloid process of the ulna and dislocation of the head of the ulna. Three years after injury ulnar nerve exposed by incision just above wrist. Nerve found to have been caught behind the head of the ulna and carried out to the back of the wrist. Two of its funiculi were intact. To free the nerve a partial resection of it was resorted to. End-to-end suture made. Examination two and a half years after operation shows considerable atrophy of the muscles supplied by the ulnar nerve. There is considerable power of adduction and abduction of the fingers. Sensation is practically restored over the area of distribution of the ulnar nerve. There has been considerable improvement in the muscles of the hand since the suture. There is very little if any disability.

CASE XX.—*Division of the right ulnar nerve just above the wrist*, the nerve being divided by the lower end of the upper fragment of the radius which was driven through the soft tissues of the anterior surface of the forearm. Infection with sequestration of the lower part of the radius. Removal of sequestrum with immediate insertion of bone transplant in infected field. Rapid healing with growth of transplant. Secondary nerve suture eight months after accident, with but little return of function, but no great disability.

CASE XXI.—*Ulnar nerve paralysis*, late sequel to fracture at elbow-joint when a boy of seven years. A cubitus valgus remained as the result of the injury. Twenty-two years later, tingling and numbness along the distribution of the ulnar nerve developed, with progressive atrophy of interossei muscles and of the hypothenar eminence. Three years later he presented all the classical signs of ulnar nerve paralysis. The ulnar nerve was then exposed behind the internal epicondyle of the humerus and found flattened as result of its displacement from its normal groove and its long-continued stretching over the epicondyle. The groove was very shallow. The nerve was freed and placed in a groove made by chiselling out a wedge-shaped piece of bone after the periosteum was reflected. The tissues were then sutured over the nerve to prevent displacement again.

This patient was examined April 18, 1922. There has been practically a complete restoration of the function of the muscles of the hand. Patient uses it as well as the other, but it tires somewhat more easily.

CASE XXII.—*Late ulnar nerve paralysis* following fracture of the external condyle of the humerus, the symptoms beginning twenty-three years after the injury. At the age of seven this patient fell and injured his left elbow. He recovered from this injury and had no further trouble until he was thirty years of age, when the signs of ulnar nerve paralysis began to develop, finally exhibiting all the signs and symptoms of ulnar nerve palsy. An X-ray revealed an ununited fracture of the external condyle, two fragments being placed anteriorly. No operation was performed and the symptoms persisted until the patient's death.

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CASE XXIII.—*Late ulnar paralysis* developing thirty-five years after a fracture of the external condyle of the humerus, which remained ununited with development of marked cubitus valgus. After two and a half years persistence of the ulnar symptoms, the nerve was exposed and found to be the seat of a fusiform enlargement, and to be adherent to the surrounding structures. The nerve was freed and the sheath incised.

An examination made April 5, 1922 (three years after operation) reveals a typical ulnar nerve paralysis. The patient states that about one year after the operation the pain commenced to subside and that at present he is free from discomfort. There is a tingling sensation along the little finger when touched, but the sensation along the ring finger has returned to normal.

CASE XXIV.—*Late ulnar paralysis*, sequel to fracture involving the left elbow, injury sustained when four years of age. Recovered with deformity. At age of eight years signs of ulnar defect developed by attempt at violin playing. These symptoms still persist, with marked underdevelopment of the left hand, both in size and muscular power, and vascular supply. Patient avers that the hand is growing gradually worse. It tires more easily, and the times when it becomes numb and painful are more frequent and longer. Operation advised but not accepted.

CASE XXV.—*Late ulnar paralysis*, sequel to a compound fracture of the lower end of the humerus. Injury sustained when ten years of age. Marked gun-stock deformity remains. No nerve symptoms until he was thirty-three years of age, when, after prolonged work in dissecting room, he began to suffer pain in the area of distribution of the ulnar nerve. At the present time there is partial anæsthesia and loss of sensation over the ulnar side of the hand, little finger and exactly one-half of the ring finger. Delicate touch is more acute. The motor power of the muscles supplied by the ulnar nerve is, according to the patient's statement, almost unimpaired. The adductor pollicis and the interossei muscles are atrophied. When palpated behind the internal epicondyle the ulnar nerve is found to be thickened.

An X-ray taken in March, 1920, reveals an old fracture which involves the capitellum and the trochlea. Both condyles appear to be ununited. Two small fragments are found in the region of the olecranon process.

CASE XXVI.—*Paralysis of external popliteal nerve*, complicating fracture of the rim of the acetabulum and posterior dislocation of the head of the femur.

Immediately after the injury the patient noted numbness of the foot and leg and inability to flex the foot dorsalward and to extend the toes. He states that four weeks after the injury he regained power over the toes. While the anæsthesia over the outer side of the leg and the foot has decreased, there is still a very definite and rather extensive anæsthesia and a foot-drop. There is a very decided atrophy of the muscles in the leg.

An X-ray made when the patient entered the hospital revealed a fracture of the rim of the acetabulum above and posteriorly and a fracture-dislocation of the head of the femur.

At operation performed eight months after the injury, the hip-joint was exposed by a posterior incision and the sciatic nerve was first exposed just below the piriformis muscle and a considerable distance of it examined. It presented no evidence of an injury, was not included in callus or hooked over the neck of the femur. The head of the femur was reduced after the new bone in the acetabulum, which had formed in the repair of the fracture, had been removed.

No definite improvement of the anæsthesia or paralysis has been noted up to the present time. Not enough time has elapsed to permit of much improvement.

CASE XXVII.—*Injury of external popliteal nerve*, complicating compound fracture of the leg. The fracture received prompt hospital care. When the plaster cast was removed it was found that the toes could not be extended and that a foot-drop was present. The fracture united in normal time and the patient was discharged from the hospital at the end of three months. At the time of discharge the paralysis was still present, no improvement having occurred. Tingling sensations were felt over the front of both the leg and foot.

CASE XXVIII.—*Injury of external popliteal nerve*, complicating compound epiphyseal fracture at lower end of femur. Seventeen months after the injury, the boy was admitted to hospital, presenting all the signs and symptoms of a paralysis of the external popliteal nerve. An incision made over the course of the external popliteal nerve revealed the nerve to be embedded in scar tissue for a distance of three cm. The two segments of the nerve were connected by a strand of connective tissue, which contained apparently no funiculi. The nerve ends were resected until healthy funiculi were exposed and an end-to-end suture was then performed. This suture could be easily made.

A letter received six years later states that there has been no improvement in the muscles supplied by the external popliteal nerve.

CASE XXIX.—*Injury to lumbosacral cord* associated with fracture of the pelvis. The injury was attended with severe pain, radiating into both lower extremities, but especially into the left. This pain was very severe and lasted with gradually lessening intensity for over four weeks. No motor paralysis. Pelvis fractured in five places. Bladder drained.

A search of surgical literature has contributed reports of 210 additional cases of nerve injuries associated with fractures. Abstracts of these cases are included in this paper or published in the Transactions of the American Surgical Association. An analysis only of the features brought out in their study is now presented.

BONES FRACTURED WITH ASSOCIATED NERVE INJURIES

Humerus	210	Pelvis	2
Radius and ulna	14	Ulna	1
Radius	9	Tibia	1
Clavicle	7	Fibula	1
Femur	5		
Tibia and fibula	3	Total number of fractures..	253

Some of the fractures were multiple, but one nerve injury complicating these.

Of these 253 fractures the majority were simple fractures, the nerve injury being the direct result of the fracture and not one due to the direct action of the vulnerating force upon the nerve.

Type of fracture: Simple, 180; compound, 38; type not recorded, 35. Total, 253.

The following table indicates the location of the fracture associated most frequently with nerve injury: Humerus, 210; lower third, 113 (53.8 per cent.); supracondylar, 41; shaft, 25; external condyle, 25; internal condyle, 16; separation of epiphysis, 6. Middle third, 52 (27.4 per cent.); upper third, 9 (4.2 per cent.); level not recorded, 36.

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Bones of forearm, 24. Upper third, 7 (29.15 per cent.); lower third, 5; middle third, 1; level not recorded, 11.

Femur, 5. Lower third, 4 (80 per cent.); upper third, 1.

Bones of leg, 5. Upper third, 3; level not recorded, 2.

The relation between the nerve injured and the location of the fracture is indicated by the following:

Musculospiral nerve injury, 136. Humerus: Middle third fracture, 50 (36 per cent.); lower third fracture, 44 (32 per cent.); supracondylar, 22; shaft, 19; separation of epiphysis, 2; intra-articular, 1; upper third fracture, 7 (5 per cent.); level not recorded, 35.

Ulnar nerve injuries, 62. Humerus: Lower third fracture, 55 (88.7 per cent.); external condyle, 24; internal condyle, 10; supracondylar, 7; separation of epiphysis, 3; both external and internal condyles, 3; position not recorded, 8.

Radius upper third, 2; both bones of forearm, 2; ulna—middle third, 1; ulna—lower third, 1.

Median nerve injuries, 15. Humerus—lower third, 11 (73.3 per cent.); radius—upper third, 2; radius—lower third, 2.

Brachial plexus injuries, 7. Clavicle, 6 (85 per cent.); humerus—upper third, 1.

External popliteal injuries, 8. Femur, 4; fibula, upper third, 2; tibia, upper third, 1; both bones of leg, 1.

Median and ulnar nerve injuries, 2. Both fractures of humerus, middle third.

Radial and ulnar nerve injuries, 1. Supracondylar fracture of humerus.

Radial, median and ulnar nerve injuries, 1. Supracondylar fracture of humerus.

Sacral plexus injury, 1. Fracture of pelvis in region of sacro-iliac joint.

Anterior crural injury, 1. Fracture of femur—upper third.

Sciatic injury, 1. Fracture of rim of acetabulum posteriorly.

Anterior tibial injury, 1. Fracture of both bones of leg—upper third.

Musculocutaneous of leg, 1. Fracture of both bones of leg—upper third.

It has been customary to divide the nerve injuries associated with fractures into the primary and secondary. In the primary the symptoms associated with the injury occur at the time of the fracture or very soon after, while in the secondary the symptoms develop some time after the fracture occurred and may develop slowly. In some of the cases which we have seen, it has been impossible to determine from the history which could be elicited when the symptoms associated with the nerve injury developed, for the symptoms which undoubtedly had been present in many cases from the time of the injury were noted when the dressing was changed some days later. The necessity of more complete examinations of fractures must be emphasized, for complicating lesions are often overlooked and facts which are of importance in determining the prognosis and treatment to be employed are not elicited.

Of the 239 cases analyzed by us, the following figures indicate the relative frequency of the onset of the paralysis: Primary, 60 (25.1 per cent.); secondary, 99 (41.4 per cent.); late, 52 (21.7 per cent.); not recorded, 28.

The probabilities are that many of the so-called secondary paralyses should be grouped with the primary, the paralysis having not been discovered when the first examination was made, but being noted when the case or dressing was changed later. Statistics dealing with the time of onset of the paralysis will, as stated above, be inaccurate until more careful examination of fractures is made, the possibility of nerve and vessel injuries being kept in mind.

The following table indicates the nerves involved in the primary injuries, the treatment employed, the pathological changes in the injured nerve and the end-results.

Primary Paralyses—Sixty Cases

(a) Nerves involved: Musculospiral, 44 (73.3 per cent.); ulnar, 5; external popliteal, 3; median, 3; radial and ulnar, 1; radial and median, 1; median and ulnar, 1; sciatic, 1; sacral plexus, 1. Total, 60.

(b) Treatment: Cases operated upon, 38 (63 per cent.); cases not operated upon, 16 (28 per cent.); amputations, 1.

(c) Pathologic findings in cases operated upon: Anatomic division of affected nerve—radial, 13; median, 2; ulnar, 2 (28.3 per cent.).

Six in middle third of humerus; four in lower third of humerus; one in upper third of humerus; four location not recorded.

Nerve caught by end of displaced fragment of bone, 14 (23.3 per cent.); nerve interposed between the fragments, 6; nerve embedded in scar and callus, 1.

(d) End results in relation to the treatment: 16 cases not operated upon; completely recovered, 12 (75 per cent.); partially recovered, 2; result not recorded, 2.

Thirty-six cases operated upon: 23 operated upon within six months—completely recovered, 16 (66 per cent.); partially recovered, 4; end-result not recorded, 3.

Three operated upon between six months and one year. Completely recovered, 2; partially recovered, 1.

One operated upon between one and two years. Completely recovered, 1.

One operated upon between two and three years. Completely recovered, 1.

Four operated upon three years after injury. Partially recovered, 1; not improved, 3.

Four cases in which interval between operation and injury was not recorded. Completely recovered, 1; partially recovered, 3.

(e) Type of operation: Of the 36 cases operated upon neurolysis was performed in 24 (66⅔ per cent.) and end-to-end suture of the divided nerve in 12 cases (33⅓ per cent.). Resection of the humerus was performed in 5 of these 12 cases in order that the ends of the nerve could be approximated.

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The following data was found in the analysis of ninety-nine cases of secondary paralysis:

(a) Nerves involved: Musculospiral, 69 (69 per cent.); median, 11; ulnar, 7; brachial plexus, 6; external popliteal, 3; radial and median, 1; radial, median and ulnar, 1; anterior tibial and musculocutaneous, 1. Total, 99.

(b) Time paralysis was first observed: After removal of the splint, 28 (28 per cent.); during course of bone repair, 59 (59 per cent.); after union of the fracture, 12.

In two cases where the paralysis was noted after removal of the splint the nerve was found at operation to be anatomically divided.

(c) Treatment: Operated, 83 (83 per cent.); not operated, 16. Total, 99.

(d) Pathological findings in the cases operated upon: Nerve caught over end of displaced fragment, 34 (40 per cent.); nerve embedded in scar and callus, 31 (37 per cent.); nerve interposed between bone fragments, 7 (8 per cent.); nerve embedded in a bony tunnel, 7; pseudo-arthritis present, 6; nerve anatomically divided, 3; bone splinter lodged within the nerve, 1.

(e) Character of the operations: Neurolysis performed, 74 cases (89 per cent.); end-to-end suture of nerve, 8 cases (10 per cent.).

Resection of a portion of the humerus was necessary in two cases before the nerve ends could be brought together.

In one case the sciatic nerve of a dog was used to bridge a wide gap.

(f) End-result in relation to treatment: Sixteen cases *not* operated; completely recovered, 6 (37 per cent.); partially recovered, 1; result not recorded, 9.

Eighty-three cases operated. Fifty-seven operated within six months. Completely recovered, 46 (80 per cent.); partially recovered, 8; not improved, 1; result not recorded, 2.

Three operated between six months and one year. All partially recovered.

Eight operated between one year and two years. Completely recovered, 2; partially recovered, 2; not improved, 3; result not recorded, 1.

Two operated three and a half years after injury. Both completely recovered.

Then thirteen cases in which the record of the interval and the end-result were lacking.

By far the greater majority of the late paralysis are those associated with fractures about the lower end of the humerus, a paralysis of the ulnar nerve developing years after the injury, when the nerve is frequently traumatized as the result of stretching because of a cubitus valgus or because of the development of bony excrescences.

Late paralysees, 52 cases. (a) Nerves involved: Ulnar, 49 (94 per cent.); median, 2; median and ulnar, 1. Total, 52.

(b) Time of onset of the paralysis: The interval between the injury and onset of symptoms ranged between two and thirty-nine years. Interval under ten years, 7 (13 per cent.); interval between ten years and twenty years, 10 (20 per cent.); interval between twenty years and thirty years, 21 (40 per

cent.); interval between thirty years and forty years, 8 (15 per cent.); recorded as "many years," 6. Total, 52.

(c) Location of the fractures: Ulnar paralysis, 49 (all lower third of humerus); external condyle, 23 (47 per cent.); internal condyle, 10 (20 per cent.); supracondylar, 8 (16 per cent.); separation of epiphysis, 2 (4 per cent.); level not recorded, 6.

Median paralysis, 2; radius (upper third), 1; radius (lower third), 1.

Median and ulnar paralysis, 1; radius (upper end) and internal condyle of humerus.

(d) Treatment and end-results:

	Recovery		Not Improved	No Record
	Complete	Partial		
13 cases not operated		4	3	6
28 cases operated				
17 type of operation not recorded		11		6
6 neurolysis		2	2	2
2 cubitus valgus corrected by osteotomy....	1	1		
1 cystic bone tumor removed from ulnar groove	1			
1 new groove for nerve chiseled out.....	1			
1 end-to-end suture of nerve	1			
	4	18	5	14

11 cases no record as to treatment or result

The results of the examination of the data which have been found in the literature and afforded by our cases may be shortly summarized as follows:

1. Eighty-eight per cent. of fractures associated with nerve's injury are of the *humerus*.

2. Fifty-three per cent. of fractures of the humerus are of the *lower third*. Twenty-five per cent. of fractures of the humerus are of the *middle third*.

3. Of the nerves involved in fractures: 57.6 per cent. are *musculospiral*; 25.4 per cent. *ulnar*; 5.5 per cent. *median*.

4. Thirty-six per cent. of *musculospiral* injuries are fractures of the *middle third* of the humerus. Thirty-two per cent. of *musculospiral* injuries are fractures of the *lower third* of the humerus.

5. Ninety per cent. of *ulnar* nerve injuries are fractures of the lower third of humerus.

6. Seventy-five per cent. of *median* nerve injuries are fractures of the lower third of humerus.

7. Twenty-four per cent. of *nerve injuries* associated with fractures are *primary* paralyzes. Forty-two per cent. of *nerve injuries* associated with fractures are *secondary* paralyzes. Twenty-two per cent. of *nerve injuries* associated with fractures are *late* paralyzes.

8. *Primary paralysis*: Seventy-seven per cent. were of the *musculospiral* nerve. Sixty-three per cent. of these were operated upon, twenty-eight per cent were not. Neurolysis was performed in $66\frac{2}{3}$ per cent. of the cases operated upon and end-to-end suture in $33\frac{1}{3}$ per cent. Forty-one per cent.

NERVE INJURIES AND FRACTURES

of the cases operated upon had anatomic division of the nerve. In forty-one per cent. of the cases operated upon the nerve was caught over displaced fragments. In twenty-five per cent. of the cases the nerve was interposed between fragments. Of those operated upon within six months after the fracture 70 per cent. completely recovered.

9. *Secondary paralysis*: Sixty-nine per cent. were of the musculospiral nerve. Twenty-eight per cent. were first noticed after removal of the splint. Fifty-nine per cent. were first noted during repair of the fracture. Twelve per cent. were first noticed after the fracture had united. Eighty-three per cent. of the cases were operated upon; sixteen per cent. were not. Neurolysis was performed in 89 per cent. of the cases operated upon; end-to-end suture in 10 per cent. In 40 per cent. of the cases operated upon the nerve was caught over displaced fragments. In thirty-seven per cent. of the cases the nerve was buried in scar and callus. In eight per cent. of the cases operated upon the nerve was interposed between fragments. Of those not operated upon, thirty-seven completely recovered. Of those operated upon within six months after the fracture 80 per cent. completely recovered.

10. *Late paralysis*: Ninety-four per cent. were of the ulnar nerve. In forty per cent. the onset was between twenty years and thirty years after injury. In twenty per cent. the onset was between ten years and twenty years after injury. In fifteen per cent. the onset was between thirty years and forty years after injury. In forty-seven per cent. of the cases ulnar paralysis were due to fractures of *external condyle* of humerus. In fifty-three per cent. of the cases ulnar paralysis had a marked *cubitus valgus*.

11. In the entire series of 236 cases: End-to-end suture of the nerve was done in twenty-two cases. Seven of these required resection of a portion of the humerus before the nerve ends could be brought together. Of these twenty-two cases there were fifteen complete recoveries.

It seems that the following conclusions may be drawn:

1. Nerve injuries are associated with fractures much more frequently than supposed. They are frequently overlooked because of the hasty and incomplete examination of fractures. When fractures are examined the possibility of a nerve injury should always be kept in mind.

2. The character of the injury varies greatly, from the slightest contusion from which the patient rapidly recovers, to anatomic division and callus inclusion which demand surgical interference.

3. It is often impossible to differentiate by the most careful neurological examination between physiologic interruption of the nerve current and anatomic division of the nerve.

4. There is a tendency in these cases to wait too long for spontaneous recovery.

5. When recovery has not commenced within three months after the injury, the injured nerve should be explored and the surgical procedures demanded by the pathological findings be instituted.

6. Neurolysis is the operation which will be most frequently required.

Resection of the humerus should no longer be resorted to to permit of end-to-end suture of the musculospiral nerve. Tendon transplantation should be performed in these cases.

7. The prognosis is very favorable in injuries of this type because of the frequency with which the musculospiral nerve is the one injured and because of the relative infrequency with which it is divided, only neurolysis being necessary.

8. In the late ulnar nerve palsies, transposition of the nerve to the front of the elbow will be necessary in the cases of cubitus valgus. When bony outgrowths cause the paralysis, removal of such outgrowths and the placing of the nerve in a healthy bed may be all that is required.

BONE FORMATION IN OPERATIVE WOUND CICATRICES

By WALTER M. JONES, M.D.

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THE following case I do not consider as belonging to that class of traumatic muscle ossification so commonly met with by the surgeon, known as "riding bones" in the thighs of cavalrymen, "exercise bones" in infantrymen, etc., where there seems to be a predisposition to bone formation analogous to keloid in some races. I have removed several of these bones, especially from the deltoid and quadriceps. In 1914 Fay¹ reviewed this phase of the subject very thoroughly, and stated that at that time over five hundred reports of muscle ossification had been made. He discusses four etiological theories: (1) The hæmic; (2) the aberrant sesamoid bones; (3) periosteal origin; (4) ossifying myositis, and remarks that the theory of periosteal dissemination, of periosteal flap detachment, of ossifying myositis in the sense of an inflammatory process due to infection or chemical irritation, are alike unconvincing, while on the other hand, the marked resemblance to the callus of fractures suggests a reparative process. He reports six cases of intramuscular ossification and concludes that it is impossible to study the subject until we are able to reproduce these bones.

Capelle,² in 1911, reports *two new cases*, one in a workman of thirty-four years, the other in a merchant of sixty-three years, in which bony formation occurred in laparotomy wounds. Operation for gastric ulcer had been performed in both cases and silk was used for suturing. In both cases the intra-abdominal portion of the operation was uncomplicated. The second patient was difficult to close on account of tense abdominal muscles. The surface wounds in both cases healed by primary intention, but there were later complications in both scars.

In Case I, a second laparotomy through the first incision was done and no peculiarities were noted in the cicatricial tissue.

In Case II, the silk suturing broke on the ninth day, with dehiscence of the rectus, and a fistula resulted in the abdominal muscles, but the final formation of cicatricial suturing did not occur under septic conditions.

The relaparotomy wound in Case I healed uneventfully, but the fresh scar was subjected to exertion by the symptoms attending an abscess of the lungs, which ended fatally after four weeks. The necropsy showed a septic endocarditis, so that a hæmatogenous infection of the scar was possible in this case also.

In Case I, the bony formation, found at the necropsy four weeks after the original operation, was seven centimetres long and four centimetres wide. Its length corresponded exactly to the old laparotomy scar. Its development had not been watched clinically.

In Case II, the formation was noted step by step. After formation of the fistula in the hernial operative scar, a slight succulence of the right border of the rectus appeared. In the first weeks there was not much change. In the seventh and eighth weeks the infiltration hardened and extended vaguely in the direction of the muscular substance. In the ninth and tenth weeks, the entire swelling

assumed a definite form, with outline clearly defined in the direction of the muscular substance. By the end of the tenth week, development had reached its limit and gradual hardening followed. After eleven weeks a slightly curved body, from seven to eight centimetres long and two centimetres broad, was sharply set off from the soft parts. The diagnosis was confirmed twelve weeks after operation, when a specimen was chiseled from the centre of the bone.

Histologic control showed direct transition of connective tissue into bone and cartilage in both cases.

Operative trauma, as such, suturing trauma, aggravated mechanical demands on the fresh scars, and injury from infection are all possible factors in the etiology. Participation of the periosteum as an etiological factor is out of the question in the given cases. The writer suggests the possibility of a peculiar disposition of the linea alba to bony formation. Embryonic cells with atavic tendencies may occur.

Hannes^{*} in 1911 discovered a hardened growth in the cicatricial tissue of a hernial scar in a woman of sixty-one. Histologic examination identified the structure as bone. The cases of Rubesch, Roepke, and Legene are quoted. In addition to these three, only one other case could be found in literature: Sabijaquina (1910) removed from a laparotomy wound, two and one-half months after operation, a piece of bone one by one and one-half centimetres. Histologic investigation showed that it had been formed in part directly from connective tissue and in part with an intervening stage of cartilage formation. Hannes considers the traumatic theory improbable and attributes these growths to a tendency to abnormal ossification.

In all five cases the bone merged with surrounding cicatricial tissue. Although Roepke's case seems to show that the ossification extended into the musculature, the growth had not formed in an otherwise normal muscle, as occurs in circumscribed traumatic myositis ossificans. In each case the bone was embedded in the scar, not in the muscle.

Legene^{*} in 1909 reports a case in which eight months after a median incision for gastric ulcer a nodule, the size of a hazelnut, was found in the upper portion of the scar. The patient was again examined two years later and the operative wound was clearly distended. There was a hernia, and a hard growth could be felt at the superior border of the neck of the sac. Operation was performed; the ossification showed the form of half a key-ring, terminating at each side in a tapering extremity which merged into the sheath of the rectus muscle. It was completely enclosed by cicatricial tissue. Histologic examination identified the growth as bone.

The writer then experimented with muscular trauma in five guinea-pigs. Several days after injury one or two cubic centimetres of aqueous solution of phosphate acid of lime was injected around the foci of the contusions, and examination made nine weeks later. Connective tissue resulted, but there was no trace of calcification or ossification. He is inclined to believe that the explanation of this phenomenon should be sought in a general modification in the metabolism of lime salts, rather than in a local modification of the tissues.

Roepke^{*} in 1907 reports two cases. Case I, a man, aged forty years, was operated for perforating gastric ulcer. The wound was closed with catgut and healed by primary intention. Another operation five weeks later, through the same wound, showed thick bony tissue, two centimetres long and one centimetre thick, in the rectus muscle.

Case II, a man, age thirty years, was operated twice, once for appendicitis, with right rectus incision, and again for adhesions, with midline incision. Silk



FIG. 1.—Bony new growth in scar of operation for inguinal hernia.



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BONE FORMATION IN OPERATIVE WOUND CICATRICES

was used for the skin. One year after last operation, another midline incision revealed a pair of thin, bony plates, embedded in the scar. The larger was about two centimetres in diameter.

Roepeke reasons that if bruised tissue is not absorbed, a deposit of lime could occur and ossification result. Operation, as such, and also the suturing could constitute the etiologic factors in the trauma.

Rubesch* reports the case of a man, age forty-three, in which seven days after operation for liparocoele a small hæmatoma appeared in the operative wound. Twelve days later the operative wound was healed. Five months later a hard knot was found in the scar, and removed. The specimen was a flat oval, three and five-tenths centimetres long, one and five-tenths centimetres wide, and about five-tenths centimetre thick. The histologic examination showed it to be composed of coarsely fibered osseous tissue. The cicatricial tissue clearly furnished the matrix for the growth. In places, transitional stages between connective tissue and bony tissue occurred.

He states that it is not probable that the earlier hæmatoma played a rôle in the formation of the bony growth, since all traces of it had disappeared when patient was discharged; but the man was a grave-digger, and it is possible that the suturing, combined with constant bending, produced trauma. In any case, abnormal tendency must be taken into consideration as an etiologic factor.

In the case here reported there was no history of infection. The new bone was not connected with muscle in any way, but lay in the scar tissue just above the shelving portion of Poupart's ligament, and was movable. It was not attached to the pubic bone. It was easily separated from the connective tissue which extended through the little holes in the specimen. Fine, sharp spicules, or finger-like projections, reached out into the scar, but were not a part of it. Histologic examination showed the specimen to be true bone. No cartilage or connective cells were found. The bone was difficult to decalcify. It is my opinion that in taking the lowest suture to pull the internal oblique and transversalis over to where Poupart's ligament joins the pubic bone, the operator pricked the bone with his needle and carried some osteogenic cells into the wound, where they proliferated the same as the new connective-tissue cells did which formed the new scar in the reparative process. The condition suggests the possibility of growing osseous tissue outside the body.

Case Report (R. E. F., No. 12486).—American, white male, married, age thirty. Chief complaint is pain in right groin, especially after walking or bending forward. He states that in April, 1919, he injured his right side by jumping. In June, 1920, a right herniotomy was done and he was in bed sixteen days. Wound healed by primary intention. In November, 1920, he first noticed a tumor under the scar; it was painful and was movable.

Examination showed a thirteen-centimetre scar above and parallel with Poupart's ligament, also a hard, irregular tumor mass in the scar, about eight centimetres long and two and two-thirds centimetres wide, movable and tender to pressure. The right testicle was found atrophic. There were no signs of a recurrence of the hernia. The external abdominal ring was very small. The X-ray revealed a hazy, irregular, opaque mass anterior to and extending about one and one-third centimetres above the right horizontal ramus of the pubic bone. It presented the appearance of a partially calcified cartilaginous mass near the lateral extremity of the body of the pubic bone.

On October 20, 1921, the foreign body was removed from the right inguinal region. An incision was made above and parallel with Poupart's ligament, below the scar of the former operation, through skin, superficial fascia, and external oblique aponeurosis. The tumor was removed by blunt dissection and wound closed.

Pathology (Gross): Foreign body proved to be new osseous growth, about five centimetres square, irregular in outline, having many sharp projections (Fig. 1). It is the opinion of the operator that at the former operation the needle struck the pubic bone and carried a few osteogenic cells into the soft tissues; these found a good culture medium, perhaps in a blood clot, and thus the new growth was formed in the scar tissue of the herniotomy wound. Microscopically the specimen proved to be true bone.

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INTUSSUSCEPTION OF STOMA FOLLOWING GASTRO-ENTEROSTOMY

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FROM THE SURGICAL SERVICE OF BETH ISRAEL HOSPITAL

POST-OPERATIVE mechanical complications following a gastro-enterostomy are very rare at the present time. Formerly vicious circle followed gastro-enterostomy rather frequently. However, since the introduction of the no-loop posterior gastro-enterostomy vicious circle has become a historic curiosity. Nowadays the most frequent cause for vicious circle following gastro-enterostomy is the formation of kinks or bands at or around the efferent loop, thus causing regurgitation of gastric contents and bile into the stomach. If properly recognized this mechanical impediment to the outflow of gastric contents can be easily dealt with by secondary operation.

Moschcowitz and Wilensky¹ reported a case of internal hernia following gastro-enterostomy, caused by the entrance of a large portion of the small intestine into the defect in the mesocolon. Similar cases have been reported by Bryan,² Mayo and Magoun³ and others.

Mechanical complications of another type, *i.e.*, intussusception of the efferent loop, have been reported recently by various authors. Steber's⁴ patient, twenty-one years old, had a gastro-enterostomy performed one and a half years previously. Two days before admission to the hospital she began to vomit continuously. The vomitus was bloody. She was observed in the hospital for three days without operation. She died on the fourth day.

Post-mortem examination showed that an intussusception had occurred in the efferent loop. The intussusceptum, 30 cm. in length, had travelled upwards through the stoma into the stomach, filling up the stoma. The intussusceptum was gangrenous.

Hartert⁵ and Amberger⁶ have recently published cases of intussusception of the efferent loop. In both cases the intussusceptum was only about two inches long and did not reach the stoma. The intussusceptum was easily reduced in both cases. The patients made an uneventful recovery.

Baumann⁷ has reported a similar case, following gastro-enterostomy and entero-anastomosis. The intussusception was reduced without difficulty. However, it recurred six weeks later. A resection of the affected portion of the intestine cured the patient.

I have recently seen another complication causing a complete obstruction, *i.e.*, intussusception of the newly formed stoma into the stomach.

P. S., fifty-three, was admitted to Beth Israel Hospital March 25, 1920. He complained of epigastric distress for eight years. The pains are sharp and burning in character and occur fifteen minutes to one-half hour p.c. The pains are relieved by soda bicarbonate. There is marked intermission of symptoms. Patient

feels perfectly well for the period of six months, when pains recur. In the last few months his attacks have become more severe and he vomits frequently. He lost about 16 pounds in the last three months.

Status: Poorly nourished patient. Marked barrel-shaped chest. Subcrepitant râles at both bases. Systolic murmur at the apex. Abdomen negative, except for slight tenderness on pressure in the right epigastrium.

X-ray examination shows a filling defect in the duodenum and a slight six-hour residue in the stomach.

Pre-operative diagnosis: Duodenal ulcer.

Operation March 29th (Lewisohn): Median incision between ensiform process and umbilicus. A crater-ulcer, adherent to the head of the pancreas, is present in the second part of the duodenum. A typical posterior suture gastro-enterostomy and pyloric exclusion with a Pagenstecher stitch was performed. Layer suture of abdomen.

March 30th: Patient vomited small amounts of brownish fluid; relieved by gastric lavage.

March 31st: No vomiting. Condition good.

April 1st: Uneventful convalescence.

Patient seemed to make an uneventful recovery when the vomiting recurred on April 4th (six days after the operation). The vomitus was very copious, and occurred every few hours. Repeated lavage during the next two days did not bring any relief. The patient began to lose ground very rapidly. He developed a bronchopneumonia in both lungs with dullness and crepitant râles at both bases. X-ray examination of the chest showed a large area of infiltration at both bases.

The general condition of the patient grew rapidly worse. His freedom from symptoms from the third to the sixth day post-operative and the sudden onset of copious vomiting on the sixth day suggested the possibility of an acute intestinal obstruction (possibly a kink in the efferent loop, just below the stoma).

Operation April 6th: Exploration through the same incision. The findings were indeed very remarkable. The obstruction was caused by an intussusception of the whole stoma into the lumen of the stomach (Fig. 1). The intussusception began just below the level of the stoma. The anterior wall presented a distinct fold. The lower two-thirds of the anterior wall of the jejunum (Fig. 1, a) formed the intussusceptum and had disappeared into the lumen of the stomach, where a hard mass, size of strawberry, could be felt through the walls of the stomach. The lower border of the jejunum (Fig. 1, b) had followed the same course into the stomach. After it had passed the stoma, it became oedematous at the site of neck of the stoma and could not slip back automatically into its normal position. Thus there resulted a complete obstruction at the site of the stoma, causing immediate regurgitation of food, gastric juice and bile. The afferent loop was hugely dilated, the efferent loop very much collapsed. The intussusception was easily reduced. The intussusceptum was injected, but not gangrenous. On account of the discrepancy in the sizes of the afferent and efferent loops and in order to safeguard against a recurrence of obstructive symptoms an entero-enterostomy was performed.

The patient stopped vomiting immediately after his second operation. Vomiting did not recur during the subsequent six days of his illness. However, though he took nourishment well, his emaciation progressed. He developed a left parotitis on April 11th. The process in the lungs gradually extended and he died on April 14th.

No post-mortem examination could be obtained.

The intussusception must have occurred on the sixth day after the primary gastro-enterostomy, the same day that the incessant vomiting began. Coincident

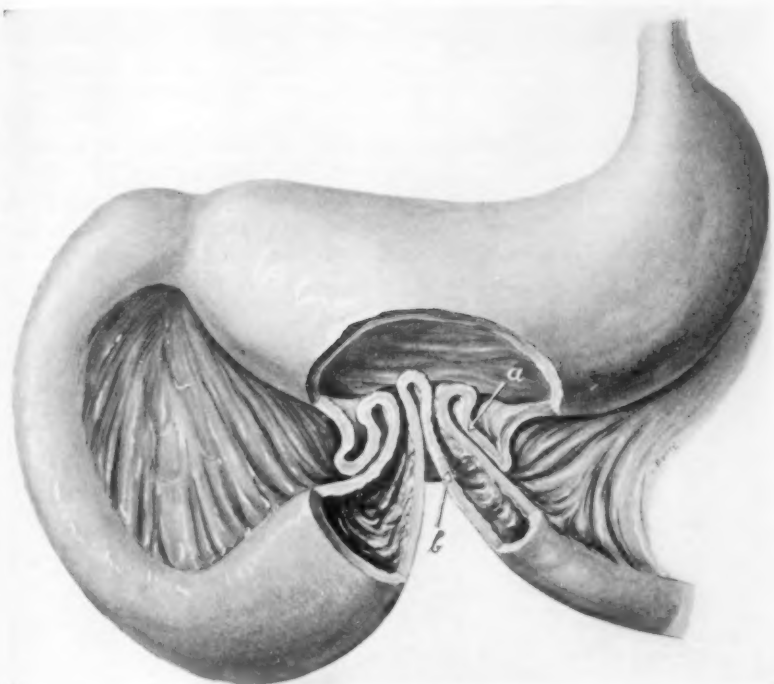
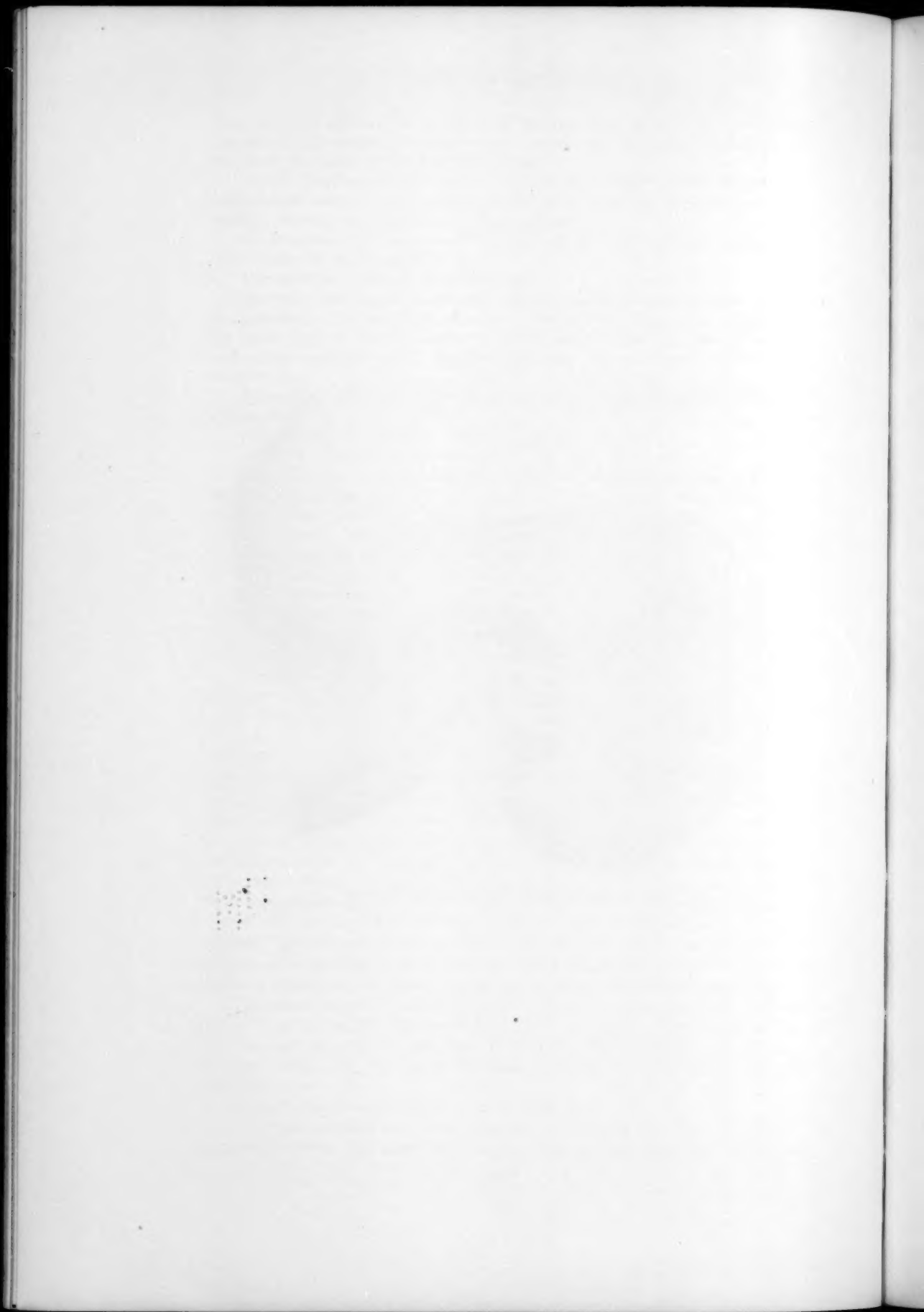


FIG. 1.—Intussusception of gastro-enterostomy stoma.



INTUSSUSCEPTION OF GASTRO-ENTEROSTOMY STOMA

with the vomiting the patient began to lose ground very rapidly, as so often observed after high intestinal obstructions.

It is certainly remarkable that in forty years of gastro-enterostomy a similar case has not been reported. Its extreme rarity seemed to warrant a brief report.

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CORRESPONDENCE

EIGHT TOES ON ONE FOOT

EDITOR ANNALS OF SURGERY:

SIR:

THE case herewith reported is of sufficient interest to be placed on record.

The patient, a babe forty days old, of Italian parentage, was referred to our service by Dr. Earnest F. Cox. Child was normal birth, breast fed, in good health; weight and size normal. Examination revealed nothing of interest excepting that there were eight digits on the left foot. This foot was broadened, because of the supernumerary toes, to the tarso-metatarsal junction. There was movement in all toes, but limited somewhat to the three medial digits. The foot, as shown in the photograph (Fig. 1), has, beginning medially, a great toe, then a corresponding second and third toe, the size one would expect to find with this great toe. Laterally from this we find five digits, normal in size and arrangement. We also note in the radiogram that all of these digits have a corresponding metatarsal bone, the size being plainly shown.

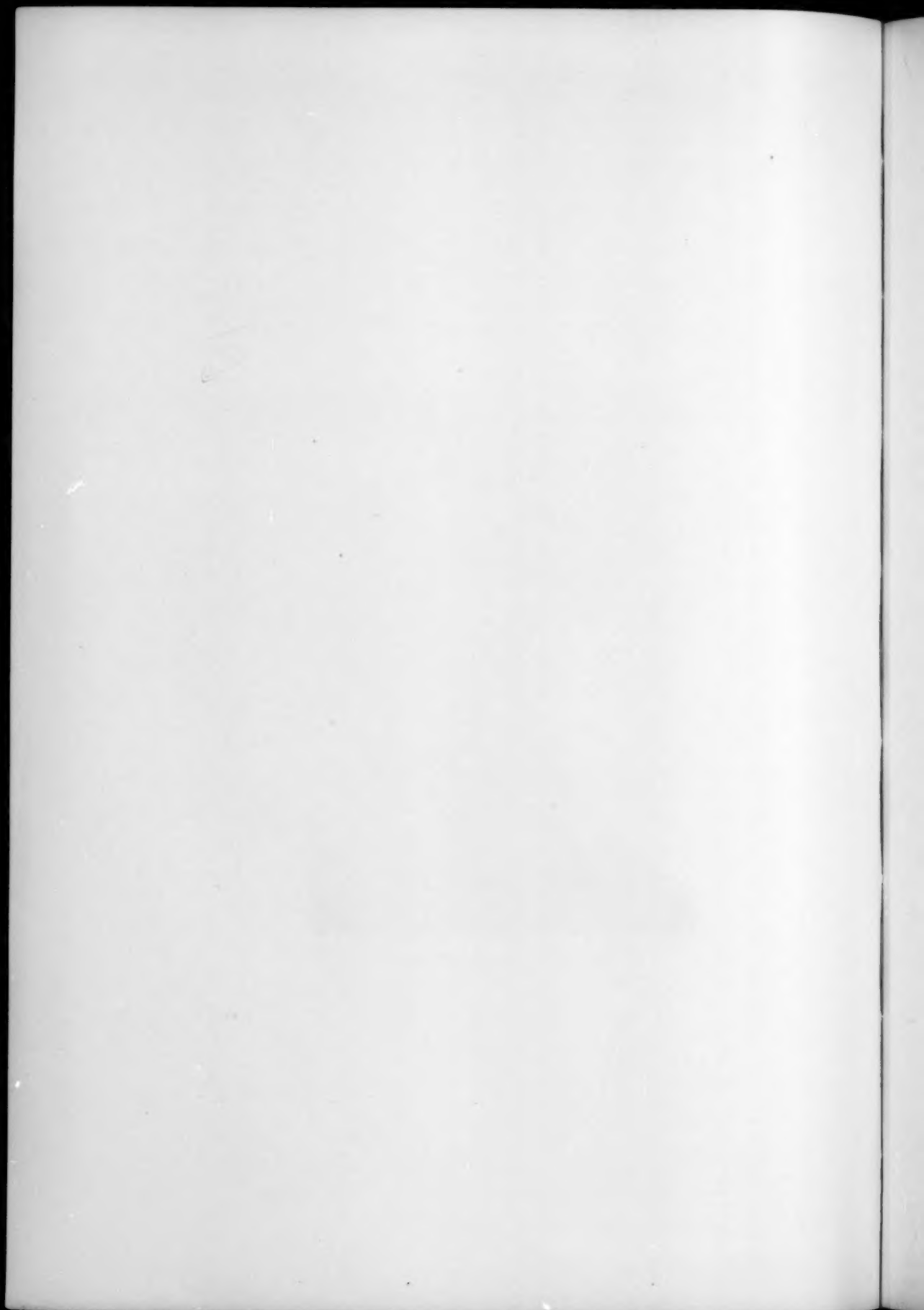
Centres of ossification for the shaft of metatarsal bones appear about the fourth month, *in utero*. Here we note that ossification is well advanced. The epiphyses, however, do not show because of the age. They usually begin ossifying in the third year of life. The phalanges are all well formed, their ossification beginning the third foetal month. Ossification in the epiphyses is not shown, this occurring at a later period. The os calcis and cuboid show ossification. The cuboid is the only small tarsal bone which ossifies before or at time of birth. The scaphoid and cuneiform bones at this period show no ossification. It will be further noted that there is a disproportion in length of the fibula and tibia of left leg with a change in their normal supero-inferior relation or position. The fibula is apparently displaced upward and is longer than the tibia.

Normal anatomy shows that the malleolus of the fibula extends one-fourth of an inch lower than the malleolus of the tibia, but the tibia extends about one-fourth of an inch above the fibula, this places the epiphyseal line at a corresponding level. The radiogram measurement shows the fibula to be two and five-eighths inches in length, while the tibia is two and three-eighths inches. This difference in length and position places the fibula five-eighths inch nearer.

On August 2, 1921, we removed the three medial toes with their metatarsals. Small tendons were noted to the digits. The wound healed nicely, leaving only a slight irregularity on the inner border of the foot. On May 11, 1922, we examined the foot and had another X-ray taken. The babe wears same size shoe on both feet and shows very little irregularity of inner margin of foot. She walks in her



FIG. 1.—Radiogram showing eight digits on one foot.



CORRESPONDENCE

walking frame and does not favor the left foot. Function seems to be normal. The radiogram, after operation, shows that the proximal ends of the metatarsal bones project obliquely with slight lateral displacement of the proximal ends of the metatarsal bones. It shows ossification in the tarsal bones which was not present at time of operation.

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EFFECTS OF SODIUM CITRATE ON BLOOD COAGULATION

EDITOR, ANNALS OF SURGERY:

SIR:

In a paper entitled "Intramuscular Administration of Sodium Citrate" (ANNALS OF SURGERY, 1922, vol. lxxvi p. 1), Neuhof and Hirshfeld state:

"The experiments consisting in the intravenous injections of solutions of sodium citrate were performed on dogs under ether anæsthesia. In brief, they established the following hitherto undescribed results of the administration of sodium citrate: (1) The coagulation time is tremendously shortened within a few minutes of the introduction of non-toxic doses of sodium citrate and this shortened coagulation may be sustained for one or more days," etc.

The fact that sodium citrate, introduced into the blood stream, would shorten the coagulation time considerably, was first noted by the late Doctor Weil in 1914. I quote verbally from his paper ("Sodium Citrate in the Transfusion of Blood," *J. A. M. A.*, 1915, vol. lxiv, p. 425):

"A possible objection is based on the influence of sodium citrate on the coagulation time of the donée. This has been tested for me in a series of cases by Doctor Beck of the General Memorial Hospital. The figures indicate that the introduction of large amounts of 20 per cent. sodium citrate solution do not lower the coagulation time in the least. In fact, five gm. of sodium citrate reduces the coagulation time by one-half. The tests have been made on blood aspirated from the vein immediately before and ten minutes after the injection. It gradually returns to normal."

Weil's dose (five gms.) is practically identical with Neuhof and Hirshfeld's "optimum" dose of six gms., used in the attempt to control hemorrhage.

In a paper entitled "A New and Greatly Simplified Method of Blood Transfusion," *Med. Rec.*, 1915, vol. lxxxvii, p. 141, I reported the following animal experiments:

"The normal blood taken from the carotid artery of the dog before the experiment was started, showed five minutes coagulation time. Three hundred c.c. of blood were then removed from the artery mixed with five c.c. of 10 per cent. sodium citrate solution and then reintroduced into the jugular vein. Three specimens of blood, taken from the carotid artery at intervals of three

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minutes after injection of the blood into the jugular vein, showed that the blood clotted in ten seconds."

In order to show that I was well aware of the fact that this shortening of the coagulation time was due exclusively to the action of sodium citrate, I quote from another paper ("Modern Methods of Blood Transfusion," *Journ. Am. Med. Assoc.*, 1917, vol. lxviii, p. 826):

"How does sodium citrate affect the coagulation time of the blood? The introduction of citrated blood causes a temporary shortening of the coagulation time of the recipient's blood. The coagulation time returns to its previous level in less than twenty-four hours."

It is thus apparent that the temporary shortening of the coagulation time following the intravenous administration of sodium citrate was observed by Weil and myself seven years ago. Neuhof and Hirshfeld's observations confirm these findings. However they do not represent any "hitherto unknown" facts.

On the other hand, the intramuscular administration of sodium citrate in the attempt to control hemorrhage as conceived by Neuhof and Hirshfeld opens an entirely new field. This part of the work, if corroborated by further observations, might represent an important step forward in our treatment of hemorrhage.

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